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AQUAPHYTE

CENTER FOR AQUATIC PLANTS
Institute of Food and Agricultural Sciences
University of Florida

With Support From
The Florida Department of Natural Resources
The U.S. Army Corps of Engineers, Waterways Experiment Station,
Aquatic Plant Control Research Program

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BIOCONTROL MISTAKE?

There have been recent successes with the biological control of aquatic weeds, all involving exotic insects and fish which eat the plants. "Success" here is defined as a degree of aquatic plant control with minimal effects on "non-target" species.

However, back in the 1930s, biological control was a new science and the importation and use of exotic species was not as closely monitored as it is today.

In the 1930s, nutrias *(Myocastor coypus)*, semi-aquatic fur-bearing rodents, were imported from South America to Louisiana to help clear the state's waterhyacinth-choked coastal waterways. It was expected that the animals would control plants and also

[See NUTRIA on page 2]

Myocastor coypus. Nutria are causing major problems in Louisiana. In tests, they consumed 88% of the transplanted baldcypress seedlings within three days of planting.

NO STRINGS ATTACHED

The **Aquatic Plant Information Retrieval System (APIRS)** collects all printed information about aquatic plants and makes bibliographic information available, free of charge, to more than two thousand aquatic systems researchers, managers, agencies, private companies, and students in the United States and Canada. APIRS is part of the University of Florida **IFAS Center for Aquatic Plants** in Gainesville.

The collection includes information about aquatic plant biology and ecology; methods of control of nuisance plants; and utilization of aquatic plants for pollution control, energy production, revegetation, food products and so on. It is the only comprehensive computerized information exchange system devoted to aquatic plants.

The collection is the result of the interest and cooperation of hundreds of researchers and research centers who have contributed more than **25,000 reprints, books and reports.** Approximately 200 items are added to the database each month.

In exchange for contributions of articles and books, the system computer produces and delivers to our users bibliographic lists of references from the database. These lists (printouts) are produced according to the users' own specified interests.

The system provides update (**"current awareness"**) information services to more than 700 researchers, as well as **"retrospective"** services to several

[See APIRS on page 6]

To Our Update Friends

To the more than 700 North Americans who receive bibliographic "updates" from APIRS: GREETINGS!

Yes, it has been a while since you last received updates from the aquatic plant database. This is to let you know that update mailouts will resume within 4 months and will be regular thereafter.

This office has been in the time-consuming process of improving our computerized information exchange system.

In the meantime, of course, we continue to offer "retrospective" printouts from the database.

To Our Overseas Friends

To the more than 1,500 of you in 58 other countries who used to receive our information exchange services: GREETINGS!

We are sending you this newsletter to let you know that we are still in business.

We continue to seek international sponsorship so that we can again provide our services to scientists throughout the world.

In the meantime, **THANK YOU** to those of you who have continued to contribute your research articles and books to the database.

We hope to renew our services to you in the near future.

FLORIDA AQUATIC WEED SHORT COURSE

JUNE 20-23, 1988
UNIVERSITY OF FLORIDA
GAINESVILLE

The purpose of the **Florida Aquatic Weed Short Course** is to provide training for new people in the aquatic plant management profession and to serve as a review for more experienced persons. Basic topics in aquatic plant management, including herbicide technology, mechanical removal, biological control, aquascaping, aquatic plant identification and more will be presented.

The "Core" and "Aquatics" tests for Florida Certified Pesticide Applicator Certification also will be administered at the end of the training.

This year's short course, which has been modified from previous years, will be held the week of June 20th at TREEO, the University of Florida's Center for Training, Research and Education for Environmental Occupations, in Gainesville.

The course is sponsored by the Institute of Food and Agricultural Sciences (IFAS), University of Florida, and the Florida Aquatic Plant Management Society.

For more information, contact: K.A. Langeland, Center for Aquatic Plants, 7922 N.W. 71st Street, Gainesville, FL 32606. (904) 392-9613.

HERBICIDE DILUTION STUDIES CONTINUE

Dye studies to determine the dilution rates of herbicides in flowing water situations continue in spring-fed canals near Crystal River. Principal investigators are Dr. Alison Fox and Dr. William Haller of the IFAS Center for Aquatic Plants.

Based on their work last fall, the researchers were able to recommend specific herbicide timing for an endothall treatment of hydrilla in one of the canals.

The researchers have begun the next phase of study which will look at the effects of water temperature on herbicide dilution and movement patterns. This phase should be complete by December 1988.

Above, cooperating researchers Dr. Kurt Getsinger and Mr. Reed Green of the U.S. Army Corps of Engineers Waterways Experiment Station (Vicksburg, Mississippi), monitor the project for WES and have assisted in field sampling.

Nutria [From page 1]

help boost the state's fur-trapping industry. The idea worked to an extent: the animals did proliferate, do eat waterhyacinth, and have become the "mainstay of Louisiana's fur industry." Louisiana is the leading fur-trapping state in the nation.

Now, however, researchers at Lousiana State University's Center for Wetland Resources (supported by the Sea Grant College Program) are studying major detrimental impacts of the beaver-like animal.

While landowners and lumber companies are attempting to re-vegetate baldcypress forests, nutrias are eating the cypress seedlings as fast as they are being planted. LSU researchers have conducted a number of fencing and other experiments to protect transplanted cypress seedlings from the nutria but have enjoyed little success.

While Louisiana suffers huge losses of coastal marsh every year, nutrias are eating *Sagittaria latifolia* and other plants which colonize islands of mud and reduce the rate of marsh loss. LSU research data so far indicates that a state-wide plan must be developed to manage the nutria population so the marshes can recover.

The December 1987 issue of *AQUANOTES* (the quarterly newsletter of the LSU Sea Grant College Program) chronicles the nutria and plant studies of William H. Conner, James Gosselink, Charles Sasser, Debbie Fuller and Elaine Evers.

For more information, or to subscribe to *AQUANOTES*, contact the Center for Wetland Resources, Louisiana State University, Baton Rouge, LA 70803-7507.

The AQUATIC PLANT INFORMATION RETRIEVAL SYSTEM has only 8 articles about nutria including two in which nutria are documented to have removed large areas of cattails and are blamed for the extirpation of blue water lilies (*Nymphaea caerulea*) in Israel.

AT THE CENTER

WHAT THEY KNOW

Studies are underway to determine which areas of education need to be strengthened for aquatic plant management personnel in Florida. This information will be used to develop better Extension education programs and materials. The work is being conducted by Vic Ramey of the IFAS Center for Aquatic Plants.

One method being used in the study is an "item analysis" of answer sheets of those who passed the state aquatic pesticide applicator examination during the period June-December 1987. The test must be passed to receive an aquatic pesticide applicator license in Florida. Of those who took the test, 10% failed and are not included in the analysis.

Item analysis of the state test results determines which questions are most often missed, and which alternative answers are most often chosen. Preliminary analysis indicates that more education is needed in the areas of aquatic plant identification, biological control, herbicide selection and ecological consequences of aquatic plant management.

Here are some preliminary results of the item analysis:

- 27% of those who passed the test could not say that spatterdock and pickerelweed are emergent plants, and 10% could not say that hydrilla is a submersed plant;
- 19% were unaware of the successful biological control of alligatorweed in Florida by the alligatorweed flea beetle;
- 28% believed glyphosate is used to control algae and hydrilla, and 30% believed copper is always toxic to fish;
- 25% believed killing large amounts of aquatic plants may cause large increases in dissolved oxygen.

The Center will issue a final report on the state test item analysis in September 1988.

ANNUAL RESEARCH REVIEW

We are in a "new age of cooperation" said Dr. Gerald Zachariah, interim University of Florida Vice-President for Agricultural Affairs, as he reaffirmed IFAS support to help solve aquatic plant problems in Florida. He noted that the consequences of these problems have resulted in concerted attention and information sharing by many agencies.

Zachariah was welcoming more than 130 researchers, regulators and managers from several dozen Florida universities and agencies to the annual aquatic plant research review.

The review was organized and chaired by Center Director Dr. Joe Joyce and was co-sponsored by the Center and the Florida Aquatic Plant Management Society.

Researchers described their current studies and results:

[See RESEARCH on page 13]

PUBLIC EDUCATION

As more new people move to Florida, and more demands are made on our waterbodies, the need to answer questions from the public increases. Many new residents have never experienced aquatic plant infestations and question the need for and methods of aquatic plant management.

The Center continues to offer assistance to local authorities to help explain to the public the necessities and methods of aquatic plant management.

The Lake County Water Authority and the Center recently sponsored three public meetings in Leesburg, Clermont and Tavares. Above, Mr. Will Davis, Executive Director of the Authority, leads a discussion on hydrilla, grass carp, fisheries and management costs with the Leesburg audience.

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Dr. Joseph Joyce, Director

COMPETITION STUDIES

From an IFAS Soil Science Department seminar, **INTERRELATIONSHIPS AMONG SOME AQUATIC PLANTS,** *given by visiting scientist Dr. Moshe Agami, of the Botany Department, Tel Aviv University, Israel. Until July, 1989, his address is Soil Science Department, 106 Newell Hall, IFAS, University of Florida, Gainesville, Florida 32611 (904)392-1804.*

There is much interest in the use of aquatic plants in wastewater treatment systems. Often, these systems use a monoculture of plants such as waterhyacinths to extract nutrients and other pollutants from the wastewater. Moreover, aquatic plant biomass might be of value for protein production and as feedstock to produce methane (biogas), fibers, etc.

Dr. Agami conducted several outdoor experiments to compare the biomass dynamics of monoculture and polyculture with several free-floating aquatic plant species. He wanted to determine if polyculture had advantages over monoculture in terms of biomass yield, growth density and nutrient uptake. In this way, he could hypothesize which plants or combinations of plants might best suit the year-round operating requirements of waste-water treatment systems.

In vaults of nutrient-enriched water, the interactions between waterhyacinth (*Eichhornia crassipes*) vs. water lettuce (*Pistia stratiotes*), waterhyacinth vs. water pennywort (*Hydrocotyle umbellata*), and duckweed (*Spirodela polyrhiza*) vs. salvinia (*Salvinia rotundifolia*) during various growth stages were investigated using the reciprocal replacement series of de Wit.

Here are some of Agami's findings:

- Vaults planted with waterhyacinth and water lettuce exhibited "typical competition". After 5 weeks in polyculture, waterhyacinth had significantly more biomass than water lettuce; the two plants in polyculture produced much more biomass than either in monoculture. After nine weeks there were great differences in the yields of *Pistia* growing in monoculture compared to those growing in mixed culture with *Eichhornia.* This illustrates the intense competition which takes place between the two species for space in which to grow. Undoubtedly, the *Eichhornia* plants interfered with and stressed the *Pistia* in each combination in which both were grown. In a vault planted 50%-50%, after nine weeks there was almost 5 times more biomass of *Eichhornia* than of *Pistia.*
- In vaults of waterhyacinth and pennywort, the cumulative biomass of each of them after three months was higher when growing in polyculture than in monoculture. Waterhyacinth roots grew twice as much biomass when growing in the presence of pennywort, whereas root length and biomass of pennywort growing in monoculture was much higher than those growing with waterhyacinth.
- In other experiments, *Spirodela* growth was significantly suppressed after growing 35 days in polyculture with *Salvinia*.

Dr. Moshe Agami is a senior research scientist on sabbatical from Tel Aviv University. He is working with Dr. Ramesh Reddy of the IFAS Soil Science Department.

Agami has studied the effects of water pollution on the flora of rivers, the roles of ducks and fish on germination and distribution of seeds of submersed plants, and the ecophysiology of aquatic and desert plants.

He has authored or co-authored three books and more than 50 scientific papers.

A CALMING AQUATIC PLANT

Based on an article by Art Latham in **THE CENTER,** *the newsletter of the UF Health Science Center, Winter/1988.*

Research on a new and powerful tranquilizer isolated from an aquatic plant recently received a shot in the arm. The new drug may have the potential for treatment of patients with schizophrenia and other severe organic or emotional disturbances.

The drug, "manassantin A" (from Sanskrit: "peace of mind") is a constituent of *Saururus cernuus* (lizard's tail). The National Institutes of Health gave a $202,000 three-year grant to Dr. K.V. Rao of the University of Florida College of Pharmacy Department of Medicinal Chemistry. The grant enables Rao, Dr. S.K. Chattopadhyay and Dr. V.N. Puri to continue their studies on the medicinal effects of manassantin A.

In mice studies, the researchers found that injections of manassantin A can counteract the effects of amphetamine. They compare the effects of manassantin A to those of haloperidol, a tranquilizer often used in the treatment of schizophrenia. However, manassantin A appears not to cause the major side effects that haloperidol may cause, such as a drug-induced Parkinsonian state of tremors and reduced mobility.

The researchers believe the new drug might also be useful in the development of other drugs, since it lowers body temperature in mice, a necessary condition for some drug research.

A peculiarity of manassantin A is that it does not contain nitrogen, an element present in thousands of other "neuroleptic" compounds. "Any compound with this kind of activity, and that contains no nitrogen, will be very interesting," says Rao.

The Aquatic Plant Information Retrieval System has 40 articles listed under *Saururus cernuus*, including:

Rao, K.V. and F.M. Alvarez. 1982. Chemistry of *Saururus cernuus.* I. Saucernetin, a new neolignan. J. Natural Products 45(4):393-397.

Rao, K.V. and F.M. Alvarez. 1983. Manassantins A/B and Saucerneol: novel biologically active lignoids from *Saururus cernuus.* Tetrahedron Letters 24(45):4947-4950.

CHINESE AZOLLA RESEARCH

SPECIAL TO AQUAPHYTE By *Mr. Zheng Wei-Wen, National Azolla Research Center, Fujian Academy of Agricultural Sciences, Fuzhou, Fujian, Peoples Republic of China.*

[This article suggests the means by which *Azolla* and *Anabaena* recognize each other. - Ed.]

Azolla, a genus of floating aquatic ferns established by Lamark in 1873, is found on the surfaces of fresh water ecosystems in both temperate and tropical regions. In China, *Azolla* has been used historically as a green manure in rice fields and as feed for some animals such as pigs, ducks, chickens and fish.

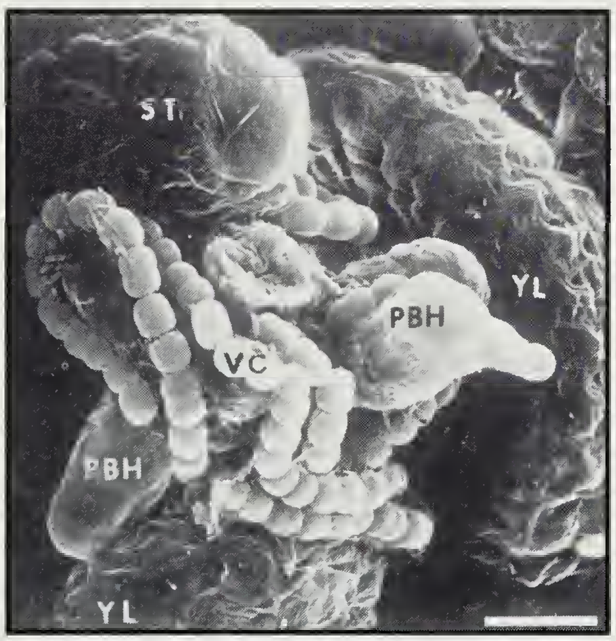
During the growth stage of the sporophyte, *Anabaena azollae*, a nitrogen fixing blue-green algae, lives in a special leaf cavity of *Azolla*. During the sporulation the filaments of *Anabaena* are partitioned into both megasporocarps and microsporocarps of the *Azolla* host.

This symbiotic association has been of interest to phytologists for years. It has been demonstrated that the algae releases fixed nitrogen to the fern and receives fixed carbon in return. However, little attention has been paid to the mechanism by which *Anabaena* infects the cavity and sporocarp of *Azolla*.

Mr. Zheng Wei-Wen

Since 1985, Zheng Wei-Wen and his colleagues at the National Azolla Center in China have studied the infecting processes of *Anabaena* using the electron microscope and microdissecting techniques.

In their studies, a special epidermal trichome called the primary branched hair (PBH) has been discovered near the shoot tip of *Azolla*. The PBH, which has a basal cell and several terminal cells, was always entangled by undifferentiated filamentous *Anabaena* which lacked heterocysts. The PBHs of the shoot tip are all in close contact with the PBHs of the two or three youngest leaves. The filaments from the apical *Anabaena* colony are partitioned into the depression forming on the youngest leaf. During development, the young leaf is displaced from the shoot tip meristem, its PBHs elongate, and a "hair bridge" is built between the shoot tip and the new cavity. The apical *Anabaena* filaments are moved into the forming cavity along the hair bridge. After entering the cavity, some vegetative cells of *Anabaena* begin to differentiate heterocysts and exhibit nitrogenase activity.



An SEM micrograph of the shoot tip of *Azolla*. The vegetative cells **(VC)** of *Anabaena* filaments entangle the primary branched hair **(PBH)** near the shoot tip **(ST)** and young leaf **(YL)**. X1300

Zheng and his colleagues also discovered that hair cells arise near the base of sporangia during sporulation of *Azolla*. *Anabaena* filaments from the meristem adhere to these hair cells. As growth continues, the filaments adhering to the hair cells can be innoculated into the young sporocarp.

The ultrastructure of both hair cells which occur in the sporophyte and during the sexual cycle have been studied by Zheng and his colleagues. Their experiments indicate that the hair cells have characteristics of transfer cells. The hair cells develop a network of ramified cell wall elaborations and have abundant ribosomes, mitochondria, dictyosomes, rough endoplasmic reticula and several proplastids.

Glycoprotein was shown to be present at the surface of the hair cell by the researchers using cytochemistry techniques. Zheng and his colleagues suggest glycoprotein may be closely associated with *Azolla's* ability to recognize *Anabaena.*

These results together with the existing physiological and biochemical information, suggest to Zheng and his colleagues that the hair cells play several important roles including recognition, transference and secretion in *Azolla-Anabaena* symbiosis. Further work to confirm or deny these hypotheses continues.

THE AQUATIC PLANT INFORMATION RETRIEVAL SYSTEM database has more than 400 articles and books on *Azolla*, including works on its symbiotic association with *Anabaena* and its use as a biofertilizer. Some 45 of these are by Chinese researchers. An excellent book on *Azolla*, which includes a list of more than 700 citations including more than 400 Chinese *Azolla* publications, is:

AZOLLA AS A GREEN MANURE: USE AND MANAGEMENT IN CROP PRODUCTION. 1982. By T.A. Lumpkin and D.L. Plucknett. 230 pp. Westview Press, Inc., 5500 Central Avenue, Boulder, Colorado 80301.

APIRS [From page 1]

hundred others. This office also produces the newsletter *AQUAPHYTE* which is delivered free to some 3,500 subscribers.

SCOPE OF THE COLLECTION

The APIRS staff collects as many reprints, reports and books as possible which discuss any aspects of aquatic plant biology, ecology, control or utilization. Aquatic plants, for the purposes of this database, are defined as plants which live in lake and river beds, the immediate shores of water bodies, wetlands, or in areas which are often flooded. Items may be about specific aquatic plants, groups of aquatic plants, or ecosystems in which aquatic plants are affected. The items may be about insects, fishes, birds or other organisms which in some way affect or utilize aquatic plants. Items may be surveys of plants in particular areas, rivers or lakes.

The database generally excludes algae. However, we have acquired materials regarding control of algae, and also have a fair amount of information on some brackish and salt water plants.

REFEREED OR NOT

All items which include anything about aquatic plants are added to the database.

ADDRESSES

Authors' addresses are not yet included in the database. However, most can be supplied upon request.

SOURCES

Our largest suppliers of information on aquatic plants are the researchers themselves. Most of the items listed in the database have been contributed by the authors. In addition, we scan many journals and proceedings, as well as the "Literature Cited" lists found in many books and articles, for relevant citations. We search for citations in a dozen other computer databases, none of which is dedicated to aquatic plants but which include some aquatic plant items. We have exchange agreements with many aquatic resource research centers throughout the world whose publications lists we scan. When a relevant citation is identified, we obtain the item from its author, from the research center or from other library sources.

THE COLLECTION

Most of the articles and books cited are part of the collection. However, we include some citations for items we do not have in the belief that some information shared is better than none. Items marked (Abstract) or (Citation Only) in the printouts indicate that we do not actually have the cited item on file. We would be pleased if users who have items that we are lacking would contribute copies to the collection.

REPRINTS

In some cases, and subject to copyright laws, we will supply some hard-to-find items to cooperating users of the system. However, users are expected to attempt to locate the required items through their own local or state research libraries.

ERRORS

The creation of a database also means making typing and factual errors. When errors are spotted, please bring them to our attention.

LANGUAGES

Items in the database are written in at least 20 languages. Where possible, citation information has been translated into English. All items can be presumed to be in English unless otherwise noted in the printouts.

"BATCH MODES" AND TURNAROUND TIME

For reasons of economy, computer services are provided in batch mode. Researchers with terminals can not "call up" our computer and conduct searches for themselves. In most cases, printouts are mailed to the requestors within 24 hours of receipt of the request.

UPDATES

"Current awareness updates" to bibliographies are provided to those who request them. Bibliographic "updates" include items recently entered into the system. They are produced and mailed to users regularly.

FULL SEARCHES

Full ("retrospective") searches of the database are provided to those who request them. Users must be specific in their requests. A typical request usually includes a plant species, a subject and/or a keyword of the literature.

A WORD ABOUT OUR SPONSORS

AQUATIC PLANT INFORMATION RETRIEVAL SYSTEM (APIRS) services are provided to those who request them in the United States and Canada. APIRS for several years provided services to overseas researchers and agencies. However, services to overseas addresses have been suspended until we obtain funding to support international services.

APIRS receives major funding for its operations from several government agencies. Our major sponsors include

- **The Florida Department of Natural Resources**
- **The U.S. Army Corps of Engineers, Waterways Experiment Station, Aquatic Plant Control Research Program**
- **The Institute of Food and Agricultural Sciences (IFAS), University of Florida**

Other significant funding for APIRS comes from

- **The South Florida Water Management District**
- **The Lake County Water Authority**
- **The St. Johns River Water Management District**

To use **APIRS** or to contribute items to the database, or to subscribe to this newsletter, contact:

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FROM THE DATABASE

During 1987, more than 600 research articles in nearly 80 refereed journals were published about aquatic plants. The Aquatic Plant Information Retrieval System (APIRS) includes most of them in its database. A sampling is listed below. To receive free bibliographies on specific plants and subjects, contact APIRS.

Abdel-Rahman, F.; Maggenti, A.R.
Meloidogyne californiensis N. Sp. (Nemata: Meloidogyninae), parasitic on Bulrush, *Scirpus robustus* Pursh.
J. Nematology 19(2):207-217
A new species of nematode has been found on Scirpus in California.

Anderson, L.W.J.; Dechoretz, N.; Bayer, D.; Darmstadt, G.L.
Effect of three formulations on uptake and efficacy of copper in *Hydrilla verticillata.*
Weed Science 35(2):263-269.

Anderson, M.G.; Idso, S.B.
Surface geometry and stomatal conductance effects on evaporation from aquatic macrophytes.
Wat. Resour. Res. 23(6):1037-1042

Ashton, F.M.; Bissell, S.R.
Influence of temperature and light on dwarf spikerush and slender spikerush growth.
J. Aquat. Plant Manage. 25:4-7

Aulio, K.
Elemental composition of *Juncus bulbosus* in an acidified freshwater reservoir.
Environmental Pollution 44(1):1-12

Azcon-Bieto, J.; Murillo, J.; Penuelas, J.
Cyanide-resistant respiration in photosynthetic organs of freshwater aquatic plants.
Plant Physiology 84(3):701-706
This is a study of Myriophyllum spicatum, Elodea canadensis, two Potamogeton species, Ruppia cirrhosa, two bryophytes and an alga.

Baker, K.K.
Systematics and ecology of *Lyngbya* spp. and associated species (Cyanophyta) in a New England salt marsh.
J. Phycol. 23:201-208

Barrett, S.C.H.; Brown, A.H.D.; Shore, J.S.
Disassortative mating in tristylous *Eichhornia paniculata* (Pontederiaceae).
Heredity 58(1):49-56

Bartley, M.R.; Spence, D.H.N.
Dormancy and propagation in helophytes and hydrophytes.
Ergebn. Limnol. 27:139-155

Baumgartner, D.L.
Laboratory evaluation of the bladderwort plant, *Utricularia vulgaris* (Lentibulariaceae), as a predator of late instar *Culex pipiens* and assessment of its biocontrol potential.
J. American Mosquito Control Assoc. 3(3):504-507
Tank experiments showed that U. vulgaris killed 50% of the mosquito larvae within 3 days at natural densities, not enough to be an effective biocontrol agent.

Beare, P.A.; Jedler, J.B.
Cattail invasion and persistence in a coastal salt marsh - the role of salinity reduction.
Estuaries 10(2):165-170

Best, E.P.H.; Visser, H.W.C.
Seasonal growth of the submerged macrophyte *Ceratophyllum demersum* L. in mesotrophic Lake Vechten in relation to insolation, temperature and reserve carbohydrates.
Hydrobiologia 148(3):231-243
C. demersum is "analagous to a typical terrestrial shade plant" in its ability to survive extended periods of stress.

Bowmer, K.H.
Nutrient removal from effluents by an artificial wetland: influence of rhizosphere aeration and preferential flow studied using bromide and dye tracers.
Wat. Res. 21(5) 591-99.
This is a study of the rates of nitrogen removal in wetlands planted with Typha, Eleocharis and Schoenoplectus.

Boyd, C.E.
Evapotranspiration/evaporation (E/EO) ratios for aquatic plants.
J. Aquat. Plant Manage. 25:1-3
Rates were determined for Panicum, Juncus, Carex, Alternanthera, and Justicia species in Alabama.

Brock, T.C.M.; van der Velde, G.; van de Steeg, H.M.
The effects of extreme water level fluctuations on the wetland vegetation of a Nymphaeid-dominated oxbow lake in The Netherlands.
Arch. Hydrobiol. Beih. 27:57-73
Nymphaeids survived dessication, but sudden, extreme flooding led to the near extinction of Nymphoides peltata.

Brookes, A.
Recovery and adjustment of aquatic vegetation within channelization works in England and Wales.
J. Environ. Manage. 24(4):365-382
Man-made channels should be designed to have similar morphological characteristics to natural channels.

Carter, V.; Rybicki, N.B.; Schulman, C.L.
Effect of salinity and temperature on germination of monoecious *Hydrilla* propagules.
J. Aquat. Plant Manage. 25:54-57
Propagule germination and growth are reduced significantly as salinity increases.

Center, T.D.
Do waterhyacinth leaf age and ontogeny affect intra-plant dispersion of *Neochetina eichhorniae* (Coleoptera: Curculionidae) eggs and larvae?
Environ. Entomol. 16:699-707
Yes, they do.

Chambers, P.A.
Light and nutrients in the control of aquatic plant community structure. II. *In situ* observations.
J. Ecology 75(3):621-628

Clay, S.A.; Oelke, E.A.
Effects of giant burreed (*Sparganium eurycarpum*) and shade on wild rice (*Zizania palustris*).
Weed Sci. 35(5):640-646
Wild rice yields were reduced 60% when burreed had high density; shading reduced yields up to 65% in 12 weeks.

[See DATABASE on page 8]

THE DATABASE
[From page 7]

Coble, T.A.; Vance, B.D.
Seed germination in *Myriophyllum spicatum* L.
J. Aquat. Plant Manage. 25:8-10
Light color and intensity affect the germination rate of milfoil seed.

Colle, D.E.; Shireman, J.V.; Haller, W.T.; Joyce, J.C.
Influence of *Hydrilla* on harvestable sport-fish populations, angler use, and angler expenditures at Orange Lake, Florida.
North American Journal of Fisheries Management 7:410-417
Hydrilla infestation caused a great reduction in the economic value of a large lake.

Cook, C.D.K.; Nicholls, M.S.
A monographic study of the genus *Sparganium* (Sparganiaceae). Part 2. Subgenus *Sparganium.*
Botanica Helvetica 97(1): 1-44.
Seven species and five subspecies are recognized, and two new names are used.

Davis, M.A.
The role of flower visitors in the explosive pollination of *Thalia geniculata* (Marantaceae), a Costa Rican marsh plant.
Bull. Torrey Bot. Club 114(2):134-138
Carpenter bees and hummingbirds tripped the styles, increasing pollination and seed production.

DeBusk, W.F.; Reddy, K.R.
Growth and nutrient uptake potential of *Azolla caroliniana* Willd. and *Salvinia rotundifolia* Willd. as a function of temperature.
Environ. Exp. Bot. 27(2):215-221

Degroot, W.T.; Dejong, F.M.W.; Vandenberg, M.M.H.E.
Population dynamics of duckweed cover in polder ditches.
Archiv fur Hydrobiologie 109(4): 601-618.
Duckweed growth threatens species diversity in Dutch ditches.

Dromgoole, F.I.; Sorrell, B.K.
Lacunar gas discharge: a valid estimate of photosynthetic rates in submerged macrophytes?
Plant Cell Environ. 10(6):515-518

Duarte, C.M.; Kalff, J.
Weight-density relationships in submerged macrophytes- The importance of light and plant geometry.
Oecologia 72(4): 612-617.
Light conditions and species allometry help determine weight-density combinations in plant stands.

Elakovich, S.D.; Wooten, J.W.
An examination of the phytotoxicity of the water shield, *Brasenia schreberi.*
J. Chem. Ecol. 13(9):1935-1940
These tests suggest Brasenia "is a promising candidate for allelopathic plant management of aquatic weeds."

Forno, I.W.
Biological control of the floating fern *Salvinia molesta* in north-eastern Australia: plant-herbivore interactions.
Bull. Entomol. Res. 77(1):9-18
After successful control of Salvinia by Cyrtobagous, equilibrium settled at 1 adult insect to every 20 plants.

Forro, L.; Metz, H.
Observations on the zooplankton in the reedbelt area of the Neusiedlersee.
Hydrobiologia 145:299-307

Friday, L.E.
The diversity of macroinvertebrate and macrophyte communities in ponds.
Freshwat. Biol. 18(1): 87-104
Diversity and composition of macrophyte communities are not adequately predicted by biogeographical factors or habitat characteristics.

Fukushima, K.; Yamamoto, S. et al.
Characterization of the microbial degradation products of a submerged plant with particular reference to the production of the kerogen-like material.
Chem. Geol. 64(1/2): 169-179
This is an analysis of organic matter contributed to lake sediments by decaying Myriophyllum spicatum.

Funaguma, T.; Hibino, Y.; Fukumori, S.; Hara, A.
Pyrophosphate- and ATP-dependent phosphofructokinases in pollen of *Typha latifolia.*
Agric. Biol. Chem. 51(9):2601-2610

Furusawa, K.
The lotus seed *Nelumbo nucifera* Gaertn. as a new host plant of the Adzuki bean weevil *Callosobruchus chinensis* L. Coleoptera bruchidae.
Appl. Entomol. Zool. 22(3):388-389
Nelumbo seeds were found to be secondary hosts to "one of the most injurious insects of stored pulses" (beans and peas).

Galbraith, J.C.
Microorganisms on water hyacinth in eastern Australia: a survey in relation to biological control by insects.
Biol. Agric. Horticult. 4(4):283-300

Gallagher, J.L.; Donovan, L.A.; Grant, D.M.; Decker, D.M.
Interspecific differences in dead plant buffering capacity after the impact of acid rain on decomposition rates in tidal marshes.
Water Air Soil Poll. 34(4):339-346
Effects of acid rain on decomposition rates of plants apparently depends on the different buffering capacities of dead plant-microbe associations.

Giroux, J.F.; Bedard, J.
Effects of simulated feeding by snow geese on *Scirpus americanus* rhizomes.
Oecologia 74(1):137-143

Glime, J.M.
Phytogeographic implications of a *Fontinalis* (Fontinalaceae) growth model based on temperature and flow conditions for six species.
Memoirs New York Botanical Garden 45:154-170
Fontinalis growth increases with temperature to 15 degrees C; above this temperature growth is reduced.

Grace, J.B.
The impact of preemption on the zonation of two *Typha* species along lakeshores.
Ecol. Monogr. 57(4):283-303

Greening, H.S.; Gerritsen, J.
Changes in macrophyte community structure following drought in the Okefenokee Swamp, Georgia, U.S.A.
Aquatic Bot. 28:113-128
"The data suggest that in these marshes, unpredictable and infrequent natural drawdowns may result in higher macrophyte diversity and greater variability in biomass dynamics than either frequent (annual) drawdown or continual inundation."

Grosse, W.; Mevi-schutz, J.
A beneficial gas transport system in *Nymphoides peltata.*
Amer. J. Bot. 74(6):947-952
A pressurized flow-through system, stimulated by increased temperature, delivers oxygen from the air to rhizomes in the anaerobic muds.

Haag, K.H.; Joyce, J.C.; Hetrick, W.M.; Jordan, J.C.
Predation on waterhyacinth weevils and other aquatic insects by three wetland birds in Florida.
Florida Entomologist 70(4):458-471
Moorhens, grackles and blackbirds do eat waterhyacinth weevils, but blackbirds may exert greater predation pressure than the others.

Harris, R.R.; Fox, C.A.; Risser, R.
Impacts of hydroelectric development on riparian vegetation in the Sierra Nevada region, California, U.S.A.
Environ. Manage. 11(4):519-528
Streamflow diversions and environmental conditions account for significant changes in community composition, structure and plant cover.

Haynes, R.R.; Holm-Nielsen, L.B.
The *Zannichelliaceae* in the Southeastern United States.
J. Arnold Arboretum 68(2):259-268
Four genera and twelve species are represented; they are all aquatic.

Hill, R.; Webb, G.J.W.; Smith, A.M.A.
Floating vegetation mats on a floodplain billabong in the Northern Territory of Australia.
Hydrobiologia 150(2):153-164
Animals concentrate on and around floating mats during dry seasons when adjacent terrestrial areas are wilted from drought.

Hogg, E.H.; Wein, R.W.
Growth dynamics of floating *Typha* mats: seasonal translocation and internal deposition of organic material.
Oikos 50(2):197-205
The annual deposition rate of Typha x glauca in Canada was found to be 704 grams per square meter, of which only 35% is contributed below ground.

Johnstone, I.M.; Robinson, P.W.
Light level variation in Lake Tutira after transient sediment inflow and its effect on the submerged vegetation.
N. Z. J. Marine Freshwater Res. 21(1):47-54

Jones, M.B.
The photosynthetic characteristics of papyrus in a tropical swamp.
Oecologia 71(3):355-359
Some reasons why C4 species like papyrus are more competitive than C3 species in freshwater wetlands are presented.

Kane, M.E.; Albert, L.S.
Abscisic acid induces aerial leaf morphology and vasculature in submerged *Hippuris vulgaris* L.
Aquatic Bot. 28:81-88

Kar, R.K.; Choudhuri, M.A.
Possible mechanisms of light-induced chlorophyll degradation in senescing leaves of *Hydrilla verticillata.*
Physiol. Plantarum 70(4):729-734
During senescence of Hydrilla leaves in light, an excess generation of hydrogen peroxide stimulates chlorophyll loss.

Kautsky, L.
Life-cycles of three populations of *Potamogeton pectinatus* L. at different degrees of wave exposure in the Asko area, northern Baltic proper.
Aquatic Botany 27(2):177-186
For plants exposed to more waves, more weight was allocated to reproductive parts, more overwintering tubers and fewer flowers were produced.

Keskitalo, J.; Ilus, E.
Aquatic macrophytes outside the Oikiluoto nuclear power station, west coast of Finland.
Annales Botanici Fennici 24(1):1-22
Around thermal discharges, Myriophyllum spicatum replaced most other plant species.

Kulakkattolickal, A.T.
Piscicidal plants of Nepal: Preliminary toxicity screening using grass carp (Ctenopharyngodon idella) fingerlings.
J. Ethnopharmacology 21:1-9.
Thirty-six plant species were found to kill fingerlings within 2 hours at 1% extract concentration or less.

Kurihara, Y.; Sato, T.; Yoshida, T.; Mori, T.
Composting sludge with reeds.
BioCycle 28(8):38-41

Leck, M.A.; Simpson, R.L.
Seed bank of a freshwater tidal wetland: turnover and relationship to vegetation change.
Amer. J. Bot. 74(3):360-370
This is a study of seed bank depletion, seed viability and the van der Valk model for succession.

Lodge, D.M.; Lorman, J.G.
Reductions in submersed macrophyte biomass and species richness by the crayfish *Orconectes rusticus.*
Can. J. Fish. Aquat. Sci. 44(3):591-597
Even low densities of crayfish can greatly reduce plant biomass, plant species diversity and invertebrate abundance.

Macfie, S.M.; Crowder, A.A.
Soil factors influencing ferric hydroxide plaque formation on roots of *Typha latifolia* L.
Plant and Soil 102:177-184
Iron in the soil, soil pH, percent organic carbon, percent inorganic carbonates and soil particle size contribute to plaque formation on wetland plant roots.

Mackowicz, R.
The birds of the lake Pogubie Wielkie in the years 1980-1984 (after the destruction of submerged vegetation).
Acta. Zool. Cracov. 30(1):25-36 (In Polish; English summary)
After the disappearance of Charales meadows, Mute Swans, coots, bitterns and drakes greatly decreased or disappeared.

Madsen, T.V.
Interactions between internal and external CO_2 pools in the photosynthesis of the aquatic CAM plants *Littorella uniflora* Aschers and *Isoetes lacustris.*
New Phytologist 106(1):35-50
This is a determination of the contribution of CAM to the total inorganic carbon balance.

Martin, B.B.; Martin, D.F.
Effects of four dyes on rates of oxygen production by three filamentous algae.
Microbios Letters 35:151-154
Rose bengal (dye) was the most effective in limiting oxygen evolution (and presumably photosynthesis), especially in Oedegonium foveolatum.

McCreary, N.J.; Carpenter, S.R.
Density-dependent growth interactions between *Eleocharis acicularis* (L.) R. & S. and *Juncus pelocarpus* forma submersus Fassett.
Aquatic Botany 27:229-241

Mishra, B.B.; Nanda, D.R.; Misra, B.N.
Accumulation of mercury by *Azolla* and its effect on growth.
Bull. Environ. Contam. Toxicol. 39(4):701-707

[See DATABASE on page 10]

THE DATABASE

[From page 9]

Moorehead, K.K.; Graetz, D.A.; Reddy, K.R.
Decomposition of fresh and anaerobically digested plant biomass in soil.
J. Environ. Qual. 16(1):25-28
Waterhyacinth which has been digested for biogas production decomposes at a slower rate than fresh waterhyacinth.

Mothes, G.
The influence of a submersed macrophyte mat on the pelagic balance of substances in the lake.
Acta Hydrochimica Hydrobiol. 15(2):161-166 (In German; English summary)
"Waters with extensive macrophyte vegetation have a relatively good water quality."

Newbold, C.; Holmes, N.T.H.
Nature conservation: water quality criteria and plants as water quality monitors.
Water Poll. Control 86(2):345

Nicholls, M.S.
Pollen flow, self-pollination and gender specialization: factors affecting seed-set in the tristylous species *Lythrum salicaria* (Lythraceae).
Plant Systematics and Evolution 156(3-4):151-157
Seed-set and seed production are estimated and compared for long, mid and short-style plants and their progeny.

Nilsson, C.
Distribution of stream edge vegetation along a gradient of current velocity.
J. Ecol. 75(2):513
In the Swedish stream, the highest number of aquatic species was found in the intermediate velocity zone (0.5 meters/second).

Ogburn, R.W.; Brezonik, P.L.; Delfino, J.J.
Effects of pH on phosphorus release during macrophyte (*Eleocharis* sp.) decomposition.
Water Resources Bull. 23(5):829

Ormerod, S.J.; Wade, K.R.; Gee, A.S.
Macro-floral assemblages in upland Welsh streams in relation to acidity, and their importance to invertebrates.
Freshwater Biol. 18(3):545-558

Panov, V.YE.; Pavlov, A.M.
Method of counting aquatic invertebrates in beds of bulrush and reed.
Hydrobiol. J. 22(6) 87-88

Paterson, D.M.; Wright, S.J.L
A continuous-flow model ecosystem for studying effects of herbicides on aquatic plants.
Weed Science 35(5): 704-710
This is a study of herbicide effects on epiphytes growing on *Elodea canadensis.*

Pezeshki, S.R.; DeLaune, R.D.; Patrick, W.H.
Effects of flooding and salinity on photosynthesis of *Sagittaria lancifolia*.
Marine Ecology Progress Series 41(1):87-91
Both flooding and salinity significantly reduced net photosynthesis.

Philbrick, C.T.; Anderson, G.J.
Implications of pollen/ovule ratios and pollen size for the reproductive biology of Potamogeton and autogamy in aquatic angiosperms.
Systematic Bot. 12(1):98-105
Hydroautogamy is proposed to define a special class of autogamy.

Phillips, J.D.
Shoreline processes and establishment of *Phragmites australis* in a coastal plain estuary.
Vegetatio 71(3):139-144

Powell, R.G.; Bajaj, R.; McLaughlin, J.L.
Bioactive stilbenes of *Scirpus maritimus*.
J. Natural Products (Lloydia) 50(2):293-296
An extract from *S. maritimus* seeds is active *in vivo* against P-388 lymphocytic (3 PS) murine leukemia.

Raspopov, I.M.; Mensutkin, V.V.; Docenko, O.N.
Aquatic vegetation dynamics during 20 years in two bays of Ladoga Lake.
Ergebn. Limnol. 27:75-82

Reinert, K.H.; Rodgers, J.H.
Fate and persistence of aquatic herbicides.
Rev. Environ. Contam. Toxicol. 98:61-98
This is a review of the literature.

Rimes, C.A.; Goulder, R.
Relations between suspended bacteria, epiphytic bacteria and submerged vegetation over the spring growing season in a calcareous headstream.
Freshwater Biol. 17(2):291-305
The daily drift loss of bacteria from the vegetated section averaged 53% and may be the source of suspended bacteria in the headstream.

Rorslett, Bjorn; Agami, Moshe
Downslope limits of aquatic macrophytes: a test of the transient niche hypothesis.
Aquatic Botany 29:83-95
Niche size and compensation depths are studied for the plants *Najas marina* and *Isoetes lacustris*.

Rosatti, T.J.
The genera of *Pontederiaceae* in the southeastern United States.
J. Arnold Arboretum 68(1):35-71

Routledge, R.D.
Rhizome architecture for dispersal in *Eleocharis palustris.*
Can. J. Botany 65(6):1218-1223
Plants with less rhizome branching may be more able to escape crowded seedbeds.

Sabol, B.M.
Environmental effects of aquatic disposal of chopped *Hydrilla.*
J. Aquat. Plant Manage. 25:19-23
A small portion (0.6%) of the stem fragments could produce new growth.

Sataka, K.
A small dredge for sampling aquatic macrophytes.
Hydrobiologia 150(2):141-142
A one-pound sampler is described.

Schmedtje, U.; Kohmann, F.
Bioindication by macrophytes -- Can macrophytes indicate saprobity?
Arch. Hydrobiol. 109(3):455-469

Schmitz, D.S.; Leslie, A.J.; Nall, L.E.; Osborne, J.A.
Hydrosoil residues and *Hydrilla verticillata* control in a Central Florida lake using fluridone.
Pestic Sci. 21:73-82
A lower application rate might have provided adequate *Hydrilla* control and possibly decreased residue concentrations in non-target areas.

Sen, A.K.; Mondal, N.G.; Mandal, S.
Studies of uptake and toxic effects of Cr(VI) on *Pistia stratiotes.*
Water Science Technology 19(1-2):119-128

Sheldon, S.P.
The effects of herbivorous snails on submerged macrophyte communities in Minnesota lakes.
Ecology 68(6):1920

Shoji, N; Umeyama A.; Saito, N.; Iuchi, A.; Takemoto, T.; Kajiwara, A; Ohizumi, Y.
Asimilobine and lirinidine, serotonergic receptor antagonists, from *Nelumbo nucifera.*
Journal of Natural Products (Lloydia) 50(4):773-774
Two drugs isolated from Nelumbo leaves counteract contraction effects of serotonin administered to rabbit muscles.

Sorrell, B.K.; Dromgoole, F.I.
Oxygen transport in the submerged freshwater macrophyte *Egeria densa* Planch. I. Oxygen production, storage and release.
Aquatic Botany 28(1):63-80

Spencer, D.F.
Tuber size and planting depth influence growth of *Potamogeton pectinatus* L.
Am. Midland Naturalist 118(1):77-84

Stevenson, S.C.; Lee, P.F.
Ecological relationships of wild rice, Zizania aquatica. 6. The effects of increases in water depth on vegetative and reproductive production.
Canadian Journal of Botany 65(10):2128-2132

Steward, K.K.; Van, T.K.
Comparative studies of monoecious and dioecious Hydrilla (*Hydrilla verticillata*) biotypes.
Weed Sci. 35:204-210
Differences in biotype physiology are reported.

Suzuki, S.; Sakurai, T.; Nakajima, T.
Characterization of plastocyanin isolated from Brazilian *Elodea.*
Plant Cell Physiology 28(5):825-832

Szczepanska, W.
Allelopathy in helophytes.
Ergebn. Limnol. 27:173-179.

Szmeja, J.
The structure of a population of *Lobelia dortmanna* L. along a gradient of increasing depth in an oligotrophic lake.
Aquatic Botany 28(1):1-14
Increasing depth alters population structure and affects reproductive strategy.

Thomas, J.D.
An evaluation of the interactions between freshwater pulmonate snail hosts of human schistosomes and macrophytes.
Phil. Trans. Royal Soc. London 315(1170):75-125
Mutualism involving snails (Biomphalaria) and several species of aquatic macrophytes is discussed.

Thompson, D.J.
Regulation of damselfly populations: the effects of weed density on larval mortality due to predation.
Freshwater Biol. 17(2):367-371
More damselfly larvae occur and fewer are eaten as weed density increases.

Tucker, C.S.; Lloyd, S.W.
Evaluation of potassium ricinoleate as a selective blue-green algicide in channel catfish ponds.
Aquaculture 65(2):141-148

Tyrrell, L.E.
A floristic survey of buttonbush swamps in Gahanna Woods State Nature Preserve, Franklin County, Ohio.
Mich. Bot. 26(1):29-38
Buttonbush shrub swamps are distinct plant communities in central Ohio.

Van Der Valk, A.G.
Vegetation dynamics of freshwater wetlands: a selective review of the literature.
Ergebn. Limnol. 27:27-39

Van Der Velde, G.; Hiddink, R.
Chironomidae mining in *Nuphar lutea* (L.) Sm. (*Nymphaeaceae*).
Entomologica Scandinavica Suppl. 29:255-264

Van Geyt, J.; Jacobs, M.; Triest, L.
Characterisation of alcohol dehydrogenase in *Najas marina.*
Aquatic Botany 28(2):129-141

Voge, M.
Photographing hydrophytic plant communities with the aid of diving gear - techniques and results.
Archiv fur Hydrobiol. 110(1):125-132 (In French; English summary)
A SCUBA appliance is presented.

Voinov, A.A.; Tonkikh, A.P.
Qualitative model of eutrophication in macrophyte lakes.
Ecol. Modelling 35(3-4):211-226
This model relates carrying capacities and macrophyte states of lakes.

Watson, D.
Hydraulic effects of aquatic weeds in U.K. rivers.
Regul. Rivers 1(3):211-227

Watson, M.A.; Cook, G.S.
Demographic and developmental differences among clones of water hyacinth.
J. Ecol. 75:439-457
Genetic fitness factors (morphology and development) were measured for three distinct clones of waterhyacinths.

Weisner, S.E.B.
The relation between wave exposure and distribution of emergent vegetation in a eutrophic lake.
Freshwater Biology 18(3):537-544

Westerdahl, H.E.; Hall, J.F.
Fluridone effects on stressed submersed macrophytes.
J. Aquat. Plant Manage. 25:26-28

Zheng, W.; Lin, Y.; Lu, P.; Liu, C.
Scanning electron microscopic observation of symbiotic relationship of *Azolla-Anabaena azollae* during the vegetative growth.
Acta Botanica Sinica 29(6):588-593 (In Chinese; English summary)
It is hypothesized that Azolla hair cells recognize and "attract" its symbiont, Anabaena.

BOOKS/REPORTS

To order the books and reports listed here, contact the publishers named.

LAKE OKLAWAHA DRAWDOWN AQUATIC VEGETATION MONITORING PROGRAM 1979-1983 by W.T. Haller and J.V. Shireman. 1987. Final Project Report of the Center for Aquatic Plants, IFAS, University of Florida for the U.S. Army Corps of Engineers, Jacksonville District, Jacksonville, Florida 32232. 329 pp.

This reports a study of the effects of drawdowns in a shallow Florida lake containing *Hydrilla*. The authors concluded that four drawdowns in a two-and-a-half year period provided only temporary reductions in *Hydrilla* coverage and did not result in long-term increases in the occurrence of native submersed species.

Drawdowns did result in reductions of viable *Hydrilla* tubers in dewatered areas. However, after each re-flooding, *Hydrilla* recolonized treated areas within 2-6 months. The authors note that there have been no significant changes in the fish population of Lake Oklawaha in the period 1971-1983 and that the sportfish population remains in "excellent condition".

Instead of annual or multiple drawdowns, they suggest an extreme drawdown every 3 to 4 years during winter to oxidize bottom sediments and desiccate stranded aquatic plant biomass.

They also suggest regular aquatic herbicide treatments to keep navigation trails open and to create "open holes" in large surface matted areas. Open areas would improve water quality for fishes and make fishing areas accessible to the public.

WEEDS OF RICE IN INDONESIA edited by M. Soerjani, A.J.G.H. Kostermans, and G. Tjitrosoepomo. 1987. Balai Pustaka, Jl. Dr. Wahidin No. 1, P.O. Box 29, Jakarta Pusat, INDONESIA. BIOTROP-NUFFIC Publication No. 3521. 716 pp.

This book primarily is an identification manual which presents drawings and descriptions of 266 weed species. A separate section includes an identification key to 150 broad-leaved weed seedlings. Other chapters introduce rice cultivation in Indonesia, the problems caused by various weeds in rice, the ecology of weeds, and weed control. There are comprehensive indexes to scientific and vernacular plant names. This work is a product of the Project on Tropical Weed Biology (1973-1978), a collaboration between BIOTROP (Indonesia) and the Netherlands Universities Foundation for International Cooperation (NUFFIC).

AQUATIC PLANTS FOR WATER TREATMENT AND RESOURCE RECOVERY, Proceedings, Conference on Research and Applications of Aquatic Plants for Water Treatment and Resource Recovery, July 20-24, 1986, Orlando, Florida, edited by K.R. Reddy and W.H. Smith. 1987. Magnolia Publishing Company, 5620 Chatsworth Court, Orlando, Florida 32806 (305) 275-7571. 1032 pp. $125.00.

This book contains the complete texts of 82 invited and contributed papers presented at the conference in Orlando, and abstracts of 65 additional papers. About 400 participants representing 22 countries attended the conference. The book is in six sections: 1) overview of global issues, 2) model systems - natural and artificial wetlands, and constructed floating macrophyte systems, 3) critical process dynamics, 4) aquatic plant management, 5) systems evaluation and 6) research and development needs.

AN ECOLOGICAL STUDY OF HYDRILLA IN THE POTOMAC RIVER; WATERFOWL SEGMENT by R. V. Folker. 1987. Report of the U.S. Fish and Wildlife Service for the U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi. Technical Report A-87-1. 33 pp.

This is a study of the use of Hydrilla by waterfowl in the Potomac River. It reports the direct consumption of the plant by ducks and geese, and surmises that birds obtain fish and invertebrate food items from hydrilla stems, leaves and interfoliar spaces. "Hydrilla is providing a valuable food resource to the Potomac River ecosystem."

AZOLLA UTILIZATION, Proceedings of First International Workshop on Azolla Utilization, March 31-April 5, 1985, Fujian Academy of Agricultural Sciences, People's Republic of China. 1987. International Rice Research Institute, Division H, Communication and Publications, P.O. Box 933, Manila, PHILIPPINES. 295 pp.

The papers collected here discuss using *Azolla* as a biofertilizer and feed for animals and fish, methods for determining its nitrogen-fixing ability, and *Azolla* taxonomy.

METHODS FOR THE USE OF AQUATIC MACROPHYTES FOR ASSESSING WATER QUALITY 1985-86 by S.M. Haslam, J.P.C. Harding and N.T.H. Holmes. 1986. The Standing Committee of Analysts, Department of the Environment, Romney House, 43 Marsham Street, London SW1P 3PY, GREAT BRITAIN. 176 pp.

This book is a step-by-step description of three methods for using macrophytes to assess water quality in the United Kingdom; two methods for streams and rivers and one for lakes and large ponds. Detailed information on field and laboratory procedures is included.

PLANT LIFE IN AQUATIC AND AMPHIBIOUS HABITATS, Special Publication Number 5 of the British Ecological Society (Produced as a Tribute to D.H.N. Spence) edited by R.M.M. Crawford. 1987. Blackwell Scientific Publications, Inc., P.O. Box 5009, Palo Alto, California 94303. 452 pp. $110.00

This is a collection of 28 papers given at an international symposium on the physiological ecology of amphibious and intertidal plants held by the British Ecological Society in March 1985.

Part I contains papers on aquatic plant ecology, underwater photosynthesis, growth, development and dispersal.

Part II contains papers on amphibious plants and flooding tolerance, oxygen stress in seeds and seedlings, root physiology under oxygen stress, and whole plant responses to oxygen stress.

USE OF GREEN PLANTS FOR IMPROVEMENT OF WATER QUALITY edited by Z. Zakova, J. Kvet, O. Lhotsky, and P. Marvan. 1987. Sbornik Prednasek, Brno, CZECHOSLOVAKIA. 195 pp. (In Czech).

This is a collection of 21 papers on the use of aquatic plants for wastewater treatment, nutrient removal and bioindication in Czechoslovakia.

THE FAMILY OF LEMNACEAE - A MONOGRAPHIC STUDY (VOLUME 2- Phytochemistry, Physiology, Application and Bibliography) by E. Landolt and R. Kandeler. 1987. Geobotanischen Institut ETH, Stiftung Rubel, Zurichbergstrasse 38, CH-8044 Zurich, SWITZERLAND. 644 pp.

This is Volume 4 of the series "Biosystematic investigations in the family of duckweeds (Lemnaceae)".

This encyclopedic work includes sections on organic and inorganic composition; cultivation; growth; effects of gases, nutrients and metals; effects of toxic substances, temperature and light; vegetative development, dormancy, flowering; metabolism, uptake, biosynthesis of amino acids; and utilization and economic importance of *Lemna, Spirodela, Wolffia* and *Wolffiela* species.

CORRECTION

A FIELD GUIDE TO VALUABLE UNDERWATER AQUATIC PLANTS by D.W. Schloesser, noted in the last *AQUAPHTYE*, is available only from: Cooperative Extension Service, Michigan State University, East Lansing, Michigan 48824. The cost is $3.50.

AQUAPHYTE SERIES

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RESEARCH REVIEW

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- **USDA Aquatic Plant Research Projects Underway.** Dr. Gary Buckingham, USDA - Gainesville.

- **DNR In-House Research Projects.** Mr. Larry Nall, DNR Bureau of Aquatic Plant Management.

- **Update of Research on the Relationships Between Aquatic Plants, Nutrients and Fisheries.** Dr. Daniel Canfield, IFAS Center for Aquatic Plants, Department of Fisheries and Aquaculture.

- **Baseline Physiology of Lyngbya.** Dr. George Bowes, Department of Botany, University of Florida.

- **Potential for the Control of Blue-green Algae with Virus.** Dr. Edward Phlips, IFAS Center for Aquatic Plants, Department of Fisheries and Aquaculture.

- **Recent Research in Managing Lyngbya.** Dr. Dean Martin, CHEM Center, University of South Florida.

- **Influence of Sediments on Aquatic Plant Growth and the Use of Seeds for Revegetation of Aquatic Plants.** Dr. David Sutton, IFAS Ft. Lauderdale Research and Education Center.

- **Use of Triploid Grass Carp in Municipal Canals.** Mr. John Cassani, Lee County Hyacinth Control District.

- **Status of Lake Apopka Restoration Demonstration and Related Projects.** Mr. Al Stewart, AMASEK Corporation.

- **Lake Okeechobee Hydrilla Harvesting for Nutrient Removal.** Mr. Ed Terczak, South Florida Water Management District.

- **Selectivity of Sonar in Lake Okeechobee.** Dr. Ken Langeland, IFAS Center for Aquatic Plants, Agronomy Department.

- **Effects of Aquatic Herbicides on "Non-target" Vegetation.** Mr. Dan Thayer, Department of Natural Resources.

- **The Effects of Low Level Stocking Rates of Triploid Grass Carp.** Mr. Rue Hestand, Florida Game and Fresh Water Fish Commission.

- **Evaluation of Dyes/Herbicides in Tidal Canals in Crystal River, Florida.** Dr. Alison Fox and Dr. William Haller, IFAS Center for Aquatic Plants, Agronomy Department.

- **Factors Affecting Glyphosate Efficacy on Torpedograss.** Dr. Donn Shilling, IFAS Center for Aquatic Plants, Agronomy Department.

- **Progress in Integrated Control of Waterhyacinths.** Dr. Kim Haag and Dr. Dale Habeck. IFAS Center for Aquatic Plants, Department of Entomology and Nematology.

- **Sonar and NMF Residues Studies.** Dr. John Osborne, Department of Biology, University of Central Florida; Mr. Don Schmitz, Department of Natural Resources; Dr. Ray Cooper, Elanco, Inc.

MEETINGS

INTERNATIONAL SYMPOSIUM ON PHYSIOLOGICAL ECOLOGY OF AQUATIC PLANTS. August 29 - September 2, 1988, Aarhus, DENMARK.

This symposium, celebrating the 25th anniversary of the Botanical Institute of the University of Aarhus, will be on the physiological ecology of macrophytes adapted to freshwater wetlands, streams, lakes, salt marshes and coastal waters.

Four sessions are planned: 1) Photosynthetic responses and carbon metabolism, 2) Salt and water stress responses, 3) Biological interaction, growth and development, and 4) Environmental conditions.

The conference language will be English. A Proceedings will be published. The symposium fee will be Dkr. 1000 (app. US$ 145). A scientific excursion also is planned.

For more information, contact: Tom V. Madsen, Secretary of Organizing Committee, Botanical Institute, 68 Nordlandsvej, DK-8240 Risskov, DENMARK.

28th ANNUAL MEETING, AQUATIC PLANT MANAGEMENT SOCIETY. July 10-13, 1988, New Orleans, Louisiana.

This international conference will be of interest to all who are concerned with the scientific and applied aspects of aquatic vegetation management. For more information, contact: G. Douglas Pullman, Publicity Committee/APMS, Cygnet Enterprises, 1014 N. Bridge Street, P.O. Box 248, Linden, MI 48451.

8th ANNUAL MEETING, MIDWEST AQUATIC PLANT MANAGEMENT SOCIETY. March 20-22, 1988, Columbus, Ohio.

The meeting will highlight new lake management technologies, applicator panel discussions, and business concerns of the professional water resource manager. For more information, contact: Robert Johnson, MAPMS, P.O. Box 100, Seymour, IN 47274.

5th CONFERENCE ON WATER QUALITY AND WETLANDS MANAGEMENT, MAN AND THE WETLANDS ENVIRONMENT. September 29-30, 1988, New Orleans, Louisiana.

The five sessions of the conference are 1) management programs for coastal and wetlands ecosystems, 2) energy resources development and impact on coastal/wetlands ecosystems, 3) dredging in the coastal wetlands, 4) impact of urban development on wetland resources, and 5) coastal ecosystems and seafood resources. For more information contact: Bud Brodtmann, LEPA Conference Chairman, 4813 W. Napoleon Avenue, Metairie, LA 70001.

INTERNATIONAL CONFERENCE ON THE INTERNATIONAL FORESTED WETLANDS RESOURCE; IDENTIFICATION AND INVENTORY. September 18-22, 1988, Baton Rouge, Louisiana.

This meeting is sponsored by the International Union of Forestry Research Organizations, Louisiana State University College of Forestry, Wildlife and Fisheries, USDA Forest Service and the Society of American Foresters.

This will be a forum about the importance of forested wetlands and how to measure and inventory them. A Proceedings will be published. For more information, contact: Ben D. Jackson, School of Forestry, Wildlife and Fisheries, Louisiana State University, Baton Rouge, LA 70803-6202.

3rd INTERNATIONAL WETLANDS CONFERENCE; CONSERVATION AND DEVELOPMENT: THE SUSTAINABLE USE OF WETLAND RESOURCES. September 19-23, 1988, Rennes, FRANCE.

Organized by the University of Rennes and the National Museum of Natural History, this conference is to "ensure the sustainable development, use and conservation of the natural resources of wetlands" and will include technical programs on floodplains, peatlands, coastal lagoons, wetland agriculture, fisheries and restoration. For more information, contact: J.C. Lefeuvre, Museum National d'Histoire Naturelle, Laboratoire d'Evolution des Systemes Naturels et Modifies, 36 Rue Geoffroy St-Hilaire, 75231 Paris Cedex, FRANCE. Registration forms also are available from R.E. Turner, Center for Wetland Resources, Louisiana State University, Baton Rouge, LA 70803.

NATIONAL SYMPOSIUM ON PROTECTION OF WETLANDS FROM AGRICULTURAL IMPACTS. April 26-28, 1988, Fort Collins, Colorado.

This symposium is sponsored by the U.S. Fish and Wildlife Service, National Ecology Research Center, and Colorado State University. Its purpose is to identify impacts by agricultural activities on wetlands, analyze federal legislation relating to wetlands, learn of state and local efforts, and develop protection strategies for various regions.

The fee will be $125 per person. For more information, contact: Henrietta Cullinane, Office of Conference Services, Rockwell Hall, Colorado State University, Fort Collins, CO 80523.

2nd ANNUAL MEETING, SOCIETY OF WETLAND SCIENTISTS, SOUTH ATLANTIC CHAPTER. April 13-16, 1988, Biloxi, Mississippi.

This meeting will be held in conjunction with the Association of Southeastern Biologists. The meeting is to "provide a glimpse of the diverse array of wetlands research and management going on in the South." For more information, contact: G.R. Best, Center for Wetlands, Phelps Lab, University of Florida, Gainesville, FL 32611. (904) 392-2424.

INTERNATIONAL CONFERENCE ON CONSTRUCTED WETLANDS FOR WASTEWATER TREATMENT. June 13-16, 1988, Chattanooga, Tennessee.

Co-sponsored by many including the TVA, EPA, SCS, NASA, and the USDA, "This will be the first conference specifically addressing the use of constructed wetlands for treating a broad array of water pollution problems with a 'hands on' workshop format." For more information, contact: Wetlands Registration, BVI, Inc., P.O. Box 4469, Chattanooga, TN 37405-0469.

50,000 FLEE OVER SEAWEED INVASION

(This is an exact transcript of a 1987 article in **National Concord**, *a Nigerian newspaper. - Ed.)*

From Tosin Fapojuwo and Sam Olukoya, Abeokuta (Nigeria)

An unprecedented mass exodus involving nearly 50,000 people has begun in the water hyacinth infested parts of Ogun State.

Inhabitants of about 30 villages, fearing complete cut-off by the ubiquitous weeds from the rest of the world, have deserted their homes.

An on-the-spot assessment of the situation by *National Concord* showed that Okera, Iluboye, Mobi, Ajelanwa, Orinyari, Mosafejo and Orubu in Ijebu East Local Government area have been completely deserted.

Further investigations revealed that Iwopin--the paper milltown--is no longer accessible by water transport as the two jetties serving it have been submerged by the weeds.

At the Iwopin Township Jetty, some fishing boats and patrol crafts belonging to the marine police have been demolished by the weeds. Light water vessels belonging to the paper mill were also affected.

Speaking with the *National Concord*, the paramount ruler of the area, Oba J. Adekoya, painted a pathetic picture of the exodus of thousands of his people from his domain.

He said the rapid incursion of the weeds into the Iwopin lagoon had defied all known solutions.

Fishermen in the area seemed to have borne the brunt of the situation as they have lost their source of daily bread.

It is estimated that over $N5 million worth of fishing equipment has been damaged by the weeds. Equipment damaged includes engine boats, nets, floats, leds, hooks and surdes.

The Ajidagan Fishermen/Fish Sellers Cooperative Union alone lost more than $N145,000 worth of equipment, their president, Chief S.O. Omokedi told *National Concord.*

Meanwhile, the contracting firm handling the clearing of the weeds, Fisesco Limited, has moved in more men and equipment from Lagos to combat the situation.

A spokesman for the firm, Mr. A. Ejilayo described the situation as "serious".

According to him, no sooner do they clear an area of weeds, than more are blown in from the Epe and Ondo State end of the lagoon.

DELTA WATERFOWL AND WETLANDS RESEARCH STATION

Canada's Delta Waterfowl and Wetlands Research Station is a privately-supported, independent research organization that has been operating since 1938. Stated objectives are the discovery and dissemination of information about waterfowl and wetland biology, and the development of specialists in waterfowl and wetland ecology. Delta funds about 20 graduate students annually. Since its inception, the station has helped students complete 91 M.S. and 50 Ph.D. studies, resulting in over 400 scientific publications and 6 books.

The Station has focused research primarily on prairie breeding grounds. Another major undertaking is the Marsh Ecology Research Program (MERP), a long-term study of the marsh ecosystem designed to test the effects of wet and dry cycles on wetland ecology. This project is operating in cooperation with Ducks Unlimited Canada. Study topics include plant ecology, nutrient cycling, and vertebrate and invertebrate ecology. Other Station projects include study of the breeding population densities of canvasback ducks and problems of waterfowl biology on wintering grounds.

The Delta Station is located on 4,000 acres of marsh owned and controlled by the North American Wildlife Foundation. The land is a maze of interconnecting shallow bays vegetated with *Phragmites* and home for a variety of plant and animal life.

In addition to research laboratories, Delta facilities include a library with one of the most complete collections on waterfowl biology in North America. Holdings include approximately 3,500 books, a reprint collection, and current subscriptions to 60 scientific journals.

Several fellowships and assistantships are available to graduate and potential graduate students. For information, contact

Mr. Bruce D.J. Batt
Scientific Director
Delta Waterfowl &
Wetlands Research Station
Rural Route 1, Portage la Prairie
Manitoba
CANADA R1N 3A1
(204)239-1900

THE AQUATIC PLANT INFORMATION RETRIEVAL SYSTEM has almost 100 articles on waterhyacinth infestations and problems in Africa.

AQUATIC PLANT INFORMATION
RETRIEVAL SYSTEM
2183 McCarty Hall
University of Florida
Gainesville, Florida 32611 USA
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AQUAPHYTE

This is the newsletter of the Center for Aquatic Plants and the Aquatic Plant Information Retrieval System (APIRS) of the University of Florida Institute of Food and Agricultural Sciences (IFAS). Support for the information system is provided by the Florida Department of Natural Resources, the U.S. Army Corps of Engineers Waterways Experiment Station Aquatic Plant Control Research Program (APCRP), the South Florida Water Management District, the Lake County Water Authority, and the St. Johns River Water Management District.

EDITOR: Victor Ramey

ASSISTANT: Karen Brown

AQUAPHYTE is sent to 3,500 U.S. and Canadian managers, biologists and agencies. Comments, announcements, news items and other information relevant to aquatic plant research are solicited.

We gladly permit free republication of *AQUAPHYTE* items when accompanied by full acknowledgement.

NEW MANUAL

IDENTIFICATION MANUAL FOR WETLAND SPECIES OF FLORIDA - Used by the Florida Department of Environmental Regulation in Determining the Landward Extent of Waters of the State. 1987. by R.L. Dressler, D.W. Hall, K.D. Perkins and N.H. Williams of the Florida State Museum Vascular Plant Herbarium, and the University of Florida Institute of Food and Agricultural Sciences. 308 pp.

This field guide was developed to facilitate the identification of wetland indicator species. The genera and species described are those the Florida Department of Environmental Regulation uses to determine the landward extent of Waters of the State of Florida under Chapter 403, Florida Statutes.

This softcover edition includes 491 color photographs and 80 line drawings. It is in 5 sections: algae and mosses, ferns, conifers, monocotyledons, and dicotyledons. Leaves, flowers and fruits are shown. Florida distributions are depicted.

TO ORDER:

Send **$18.00 each**, check or money order to Publications, IFAS Building 664, University of Florida, Gainesville, FL 32611-0001.

Florida residents, add 6% sales tax **($1.08).**

Make check or money order payable to "University of Florida".

BULLETIN!

The Aquatic Plant Control Operations Support Center (APCOSC) at the Army Corps of Engineers Jacksonville District, is now publishing the quarterly **Information Exchange Bulletin.** The bulletin covers current developments in biological, chemical and mechanical plant management technology.

The APCOSC offers free subscription to federal and state agencies, universities, corporations and to individuals interested in aquatic plant technologies. Contact:

Dr. Bill Zattau
U.S. Army Corps of Engineers
Jacksonville Distrist (SAJCO-OR)
P.O. Box 4970
Jacksonville, Florida 32232-0019
(904) 791-2218

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A Q U A P H Y T E

CENTER FOR AQUATIC PLANTS
Institute of Food and Agricultural Sciences
University of Florida

With Support From
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The U.S. Army Corps of Engineers, Waterways Experiment Station,
Aquatic Plant Control Research Program

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AQUATIC PLANT GROWERS SECOND IN AQUACULTURE SALES

Aquatic plants are now the second most valuable product in net sales value in Florida's aquaculture industry. Thirty-three aquatic plant growers reported 1987 sales of $6.7 million, second only to sales of tropical fish (at $21.7 million). The total for all aquacultural products sales was $35 million.

Among other things, aquatic plants are sold for aquariums, for food, and for wetland restoration. (Sales do not include harvests from the wild.) Although the aquarium plant industry is well-established, the restoration plant industry is relatively new and appears to be rapidly increasing in Florida.

(The figures are the result of a survey funded by the U.S.D.A. and conducted by the Florida Agricultural Statistics Service.)

Source: AQUACULTURE, May 1988

BY ANY OTHER NAME

Restoration is an increasingly common word used in the aquatic plant field whether referring to "mitigating" developed wetlands, "restoring" hypereutrophic lakes, "revegetating" or "transplanting" littoral zones in retention ponds, "aquascaping" canal banks or lake shorelines, or building ornamental water gardens.

More and more water managers, environmental engineers and landscape architects, developers, nursery growers and members of the general public are interested in culturing, growing and transplanting aquatic plants. And they need more information about the basic biology of aquatic plants, their interactions with each other, and the benefits and problems they bring with them to the restoration projects.

Many of these people come to the **Aquatic Plant Information Retrieval System (APIRS)** for research information. A recent search of the aquatic plant database revealed some 300 research articles, reports and books on cultivation, transplantation and restoration projects using aquatic plants.

Survey

Recently, APIRS surveyed those companies and agencies in Florida that work in some aspect of aquatic plant restoration, revegetation, aquascaping, plant cultivation or mitigation. Those surveyed were drawn from lists provided by the Florida Department of Natural Resources Bureau of Aquatic Plant Management, and the Florida Aquatic Plant Management Society. They included agencies and companies permitted to conduct aquatic plant restoration or permitted to sell aquatic plants.

Survey questions determined types of clients served, locations where work is

[See RESTORATION on page 4]

MORE HELP ON THE WAY

The production of instructional videotape programs about aquatic plant management is underway at the Center for Aquatic Plants. Programs are being prepared for applicators, managers and the public.

At right, writer Mimi Carr and videographer Phil Chiocchio take aim at Extension Specialist Dr. Ken Langeland as he advises Mr. Jesse Watson on what to do with a pond full of hydrilla, naiad and cattail.

TISSUE CULTURE OF AQUATIC PLANTS

A commercial grower recently reported an order for 40,000 water lilies, an order that he could not meet. In fact, more and more developers and landscape architects, and lake and wastewater treatment managers are needing more and more aquatic plants for "aquascaping" and "pollution control". Where will these plants come from?

Dr. Michael E. Kane sees tremendous commercial possibilities in tissue culture of ornamental aquatic plants. Kane, a researcher in plant tissue culture including aquatic plant tissue culture, is an Assistant Professor at UF's Institute of Food and Agricultural Sciences, Department of Ornamental Horticulture.

Tissue culture (or micropropagation) is defined as the rapid multiplication of plants from plant tissue in a sterile environment under controlled light and temperature conditions on a culture medium. It is, in effect, the clonal propagation of plants.

This technique offers many advantages over traditional methods of culture, although micropropagation is seen as a complement to, and not a replacement of, traditional propagation methods. Some of the method's advantages include efficient production, very rapid multiplication of plants, low maintenance and small space requirements. Rapid aquatic plant multiplication facilitates hybridizing programs and new cultivar introductions. Another advantage of tissue culture is the ability to store plants in cool temperatures until they are needed.

Tissue culture may prove to be the propagation method of the future as demand increases for aquatic plants for ornamental, aquarium, revegetation and pollution control purposes. The method produces disease-free, robust, attractive plants in a short time. According to Kane, some aquatic plants have an extremely high capacity for regeneration, in fact, the highest of any plants so far encountered. For example, one small shoot tip from a *Crassula helmsii* plant produced 168 nodes in four weeks in culture in Kane's lab. Leaf tissue from a *Myriophyllum heterophyllum* plant produced 1,500 adventitious shoots in a single test tube in four weeks.

Natural regeneration is enhanced in tissue culture because precise controls are available. Also, there are no growth limiting factors since all required nutrients are included in the medium. Among other possibilities, tissue culture allows researchers to: 1) study the effects on growth of one species when cultured together with another species, 2) estimate the weed potential of a species via in vitro growth study, 3) study the mechanisms regulating aquatic plant growth on the physiological/cellular level (to perhaps discover a "weak link" in *Hydrilla*, for example), and 4) examine the hormonal and environmental factors affecting growth.

Most terrestrial ornamentals sold are tissue cultured, producing cheaper and healthier plants. The same should hold true for many aquatics. However, research and development is needed to discover the best culture methods and media, which plants to grow, the best methods of transplanting cultured plants and into what media (soil, foam plugs, sealed plastic bags, etc.). Markets and demands need to be evaluated carefully.

How can you find out more about tissue culture? Micropropagation of horticultural crops is offered at UF through the Ornamental Horticulture department, but the course does not yet cover aquatics. And Kane is now writing a manual entitled *Tissue Culture of Aquatic Plants*, due to be published in 1989. He has also authored several articles about tissue culture.

For more information, contact Dr. Michael E. Kane, Assistant Professor, Plant Tissue Culture, UF-IFAS, Department of Ornamental Horticulture, 1519 Fifield Hall, Gainesville, Florida 32611. (904) 392-7937.

Pictured above, shoot tip tissue culture of *Limnophila sessiliflora*. The culture at left is at 1 days growth, the culture at right is at 14 days.

Kane's aquatic plant articles:

Aquatic plant tissue culture: A useful tool for the propagator and hybridizer? The Water Garden Journal (in press).

Aquatic plant tissue culture: Fluffing up the parrot-feather. The Water Garden Journal 4:19-23. 1988.

Direct shoot organogenesis from stem internodes of parrot-feather (Myriophyllum aquaticum), an ornamental aquatic plant. A plant tissue culture exercise. University of Florida, Institute of Food and Agricultural Sciences, Resident Instruction Journal Series No. 1, 12 pp. 1988.

Abscisic acid induces aerial leaf morphology and vasculature in submerged Hippuris vulgaris L. Aquatic Botany 28:81-88. 1987.

Integrative regulation of leaf morphogenesis by gibberellin and abscisic acids in the aquatic angiosperm Proserpinaca palustris. Aquatic Botany 28:89-96. 1987.

A laboratory exercise to demonstrate adventitious shoot formation using stem internodes of parrot-feather (Myriophyllum aquaticum). HortScience 23:408. 1988.

In vitro growth of American lotus (Nelumbo lutea) embryos. HortScience 23:611-613. 1988.

Comparative shoot and root regeneration from juvenile and adult aerial leaf explants of variable-leaf milfoil. Journal of Aquatic Plant Management (in press).

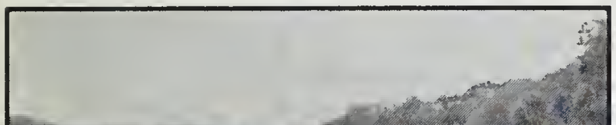
AT THE CENTER

Herbicide Studies at Myakka State Park

It was not long ago that the upper lake of Myakka State Park was filled with hydrilla. Now the hydrilla is gone. The Southwest Florida Water Management District treated the lake with fluridone.

Dr. Kenneth Langeland and assistant Mr. Francois Laroche, are monitoring the efficacy of the fluridone treatment on hydrilla, and the herbicide's effects on the non-target plant, *Nymphaea mexicana*.

In the lower part of the lake, water hyacinths are the problem. In fact, several miles of the Myakka River are covered shore to shore with the floating weed. Here, Langeland and Laroche are experimenting with the use of triclopyr (Garlon 3A), under an experimental use permit (EUP). They have found that triclopyr is as effective against water hyacinths as are diquat or 2,4-D.



Water hyacinths make several miles of the Myakka River impassable.

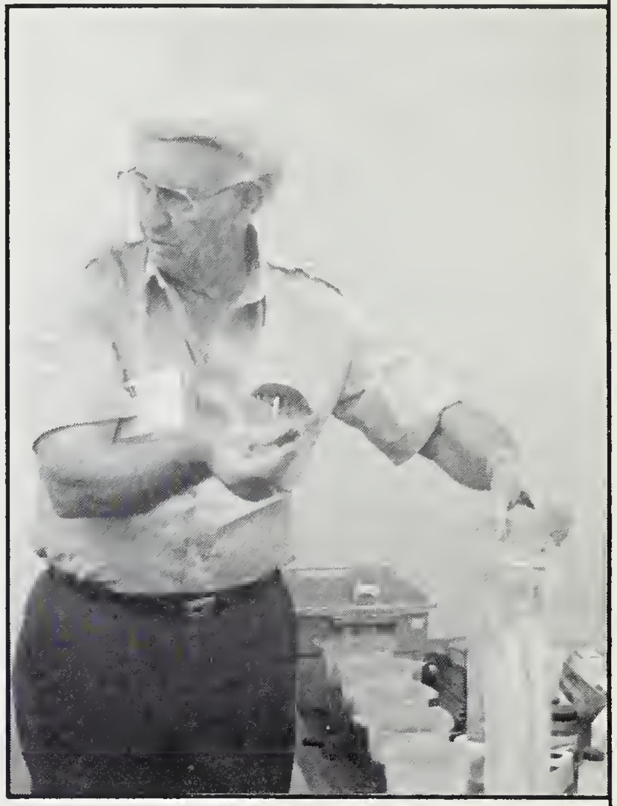
AQUATIC WEED SHORT COURSE

A capacity crowd of 175 attended the four day IFAS Aquatic Weed Management Short Course in June.

The course provided group classroom sessions and field demonstrations covering survey and measurement techniques, equipment calibration, equipment demonstration, aquatic plant identification, adjuvants, and insects and diseases on aquatic plants.

Because of the large turn-out for the short course, a second one for applicators will be held in summer 1989 in south Florida. For information, see the MEETINGS section.

The course was sponsored by the Florida Cooperative Extension Service, the Center for Aquatic Plants, the Florida Aquatic Plant Management Society, and the Institute of Food and Agricultural Sciences. It was organized by Dr. Ken Langeland.



Mr. Ivan Rash of Nalco Chemical Company demonstrates how adjuvants affect herbicide characteristics.

Survey of Applicators

A recent survey collected data about the attributes, attitudes, beliefs and work-behaviors of licensed aquatic herbicide applicators and field supervisors in Florida. The 231-item questionnaire was returned by 419 randomly selected license holders.

The survey found that a "typical" applicator has five years experience and works for a government agency. He most often uses glyphosate and controls water grasses and cattails in irrigation and flood control systems. He gets most of his work-related information from chemical companies, but believes that the best information comes from the Florida Aquatic Plant Management Society and IFAS Extension services.

The typical applicator demands more training, especially about plant identification, aquatic ecosystem ecology, maintenance control techniques and herbicide use.

Results of the survey are being used to prepare instructional videotapes and manuals and better short courses. More detailed results of the survey will be published in *AQUATICS* magazine.

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Dr. Joseph Joyce, Director

[RESTORATION from page 1]

done, most frequently used plants and where and how the plants are obtained. We asked which plants were difficult to find in which areas, which plants were purchased from or grown in nurseries, and which plants were easy to find. We asked where people learned to cultivate and/or transplant aquatic plants and whether or not they would be interested in participating in educational programs. We also asked for significant successes, failures and insights experienced.

Most of our responses were enthusiastic. It seems that the restoration business is a rapidly growing field and those working in it are proud of their work. Revegetation efforts seem to be publicly supported as accomplishments in beautification and habitat improvement. Some projects have received television and newspaper coverage.

Here, we present some of the findings of the survey regarding freshwater plant species.

Reasons for Restoration

Restoration efforts seem to be spurred by four factors. One is the relatively new government requirements and regulations regarding "mitigation". The second is the desire for aesthetically pleasing shorelines. The third is the desire to enhance wildlife habitat and the fourth is to "naturally" control exotic species.

Regulations

Many of the regulatory agencies are beginning to incorporate aquatic plants into their requirements for mitigation and development. Our survey verified that regulatory requirements are complex and that they differ depending on the size and type of the project. Among the regulatory agencies involved are the U.S. Army Corps of Engineers (which manages navigable waterways), the Department of Environmental Regulation (which is involved in developments of regional impact), the Department of Natural Resources (which manages state resources), Water Management Districts (which manage waterways within their regional boundaries), and counties and cities (which have various natural resource, pollution control and development regulations within their boundaries).

Requirements can be enforced as conditions for construction and operating permits. Some counties now require a vegetated littoral zone in lakes and/or retention ponds. Some stipulate the use of native species in these areas while others allow natural recruitment. Some even require a variety of native species with no one species allowed to cover more than 50% of the area. Native species are usually required for wetland mitigation.

Many government agencies also require systems for cleansing run-off water prior to discharge into a receiving water body. In some cases, aquatic plants are used for "biological filtration systems" instead of "underdrain filter systems" made of sand, shell and rock. Underdrain systems often do not work well due to high water levels and frequent clogging. The biological filtration systems are littoral zones with a specified percentage of plant coverage.

Although continued monitoring and maintenance of vegetated sites is often part of the requirements, some of the regulatory agencies admit that this facet is not yet well implemented and that monitoring and maintenance simply are not happening.

Where the use of aquatic vegetation is not required by regulatory agencies, it often can be recommended by these agencies or by others, such as county extension offices. Although vegetated littoral zones are not required in Manatee County, for example, the idea is promoted by Peter Mitchell, a Manatee County extension agent. Mitchell provides workshops on pond management and "pondscaping" for small urban retention ponds. He also is preparing a booklet on how to vegetate in and around ponds using native species. Together with a group of local nursery growers, Mitchell has built a small demonstration pond by the Manatee Civic Center.

Aesthetics

Although opinions vary widely as to how a water body should look, many feel that a shoreline vegetated with native species of aquatic plants is aesthetically pleasing. Additionally, many

[See RESTORATION on page 5]

WHERE

The Florida survey found that areas where revegetation efforts most often take place are, in order of frequency:

- wetlands
- lakes
- retention ponds
- ornamental ponds.

WHO

The Florida survey found that customers most often requiring aquatic plants for various projects are, in order of frequency:

- developers
- city agencies
- homeowner associations
- state agencies.

WHAT PLANTS

The Florida survey found that of 42 plants listed, the most frequently used are, in order of frequency:

- *Pontederia cordata* (pickerelweed)
- *Iris* spp. (blue flag iris)
- *Spartina* spp. (cordgrass)
- *Peltandra virginica* (arrow arum)
- *Nymphaea* spp. (fragrant water lily)
- *Panicum hemitomon* (maidencane)
- *Scirpus validus* (bulrush).

FREE DIRECTORY

A directory has been compiled from those who responded to the APIRS survey on restoration, revegetation and mitigation. If you would like a free copy of this directory, please contact APIRS.

[RESTORATION from page 4]

aquatic plants provide food, cover and nesting habitat for birds and other wildlife. It is generally believed that aquatic plants provide some amount of water quality enhancement by filtering nutrients from urban run-off and other wastewaters. Aquatic plants also provide erosion control by buffering shorelines against waves created by wind and boat traffic. Thus, native aquatic vegetation has many useful functions in an ecologically balanced system.

Where do they get the plants? About half of the survey respondents indicated that they grew their own plants. The other half indicated that they bought plants from nurseries or collected them from the wild.

Among plants listed as difficult to find were American lotus, banana lily, arrow arum, golden club, swamp lily and giant bulrush.

Almost all of the respondents stated that they learned to cultivate and/or transplant aquatic plants through their own experience. Approximately one-third of the group also listed college and/or job training in their learning experience. The survey response was overwhelmingly in favor of educational programs in the field of restoration.

Professionalism

The complaint cited most often in the survey is the lack of professionalism among some newly established businesses. According to one respondent, "Many restoration and aquascaping programs are planned by people with little knowledge of wetland ecology. Mitigation plans need to be based on sound information of wetland ecology and not be planned simply as a means of meeting regulatory requirements." Non-professionals doing poor work perpetuate the idea that restoration does not work and gives the relatively new industry a bad name.

Maintenance and Monitoring

Lack of monitoring and maintenance programs allows replanted sites to be overtaken by undesirable species or to simply die out. According to one respondent, "the guidelines concerning the maintenance of these types of systems need clarification and most importantly, enforcement procedures and methods of follow-up need to be more fully developed." There were also indications that new companies are being formed in anticipation of increased regulatory activity in the field regarding maintenance and monitoring of jobsites. Some of these companies may specialize in designing, implementing and monitoring programs, and offer design consultations for landscape architects for a fee.

Over-Collection

Another common concern is that aquatic plant donor sites (such as public rivers, lakes and wetlands) may become destroyed because of over-collection of plants. Some feel there should be state protection of wild areas from over-collection. Although collecting more than 25% of the plants in an area is a DNR permit violation, illegal practices are difficult to detect until after the damage has been done. Few people claim that over-collection is a major problem yet, but many worry about what the near future will bring as the industry grows. Illegal collecting on private lands or sloppy collecting which leaves areas unsightly is also a problem in that it can engender negative attitudes toward collection of plants from the wild.

On the other hand, some workers such as Danon Moxley of the Florida Game and Fresh Water Fish Commission, believe that moderate plant collection actually promotes new growth and improves a donor site. Moxley has been using many of the same collection sites for several years and believes they are in excellent shape.

Species Diversity

Some restorationists complain of the lack of variety in species used for restoration projects and suggest that education is needed in the design aspect of restoration. According to a respondent, the education of many landscape architects "stops at the water's edge." This gap possibly could be closed with educational programs and consulting services. Rather than using the most popular plants for every restoration job, informed designers could use a variety of species that also work well and that provide diversity. Some suppliers say that buyers consider a variety of stock a big plus for their projects. On the other hand, some feel that for the best chance of success, only the hardiest plants requiring the least amount of maintenance should be used.

Restoration Certification

Several of those surveyed called for a professional certification process, and some suggested a restoration organization that could provide a set of ethics. Either or both of these ideas could help to protect a fast-growing industry in which quality, professionalism and long-term success are crucial. *K.B.*

CLASS IN AQUATIC PLANT CULTURE AND PRODUCTION

"Culture and Production of Aquatic Plants" (ORH 4942, 3 credits) is now offered as part of the Ornamental Horticulture program at the University of Florida's IFAS Fort Lauderdale Research and Education Center (FLREC). The class is taught each fall by Dr. David L. Sutton. Initially offered as part of the Fall 1987 schedule, the class was attended by students from as far away as Sarasota, Fort Pierce and south Dade County. Dr. Sutton said, "I was somewhat surprised by the number of students who took the class. As far as I know, this may be the first offering of such a class anywhere in the country."

Class topics include aquatic plant anatomy, reproduction, growth and development, nutrition, pest control, regulations and permits, transportation and markets, and aquascaping. C.D. Sculthorpe's "The Biology of Aquatic Vascular Plants" (1985) is the major text for the class.

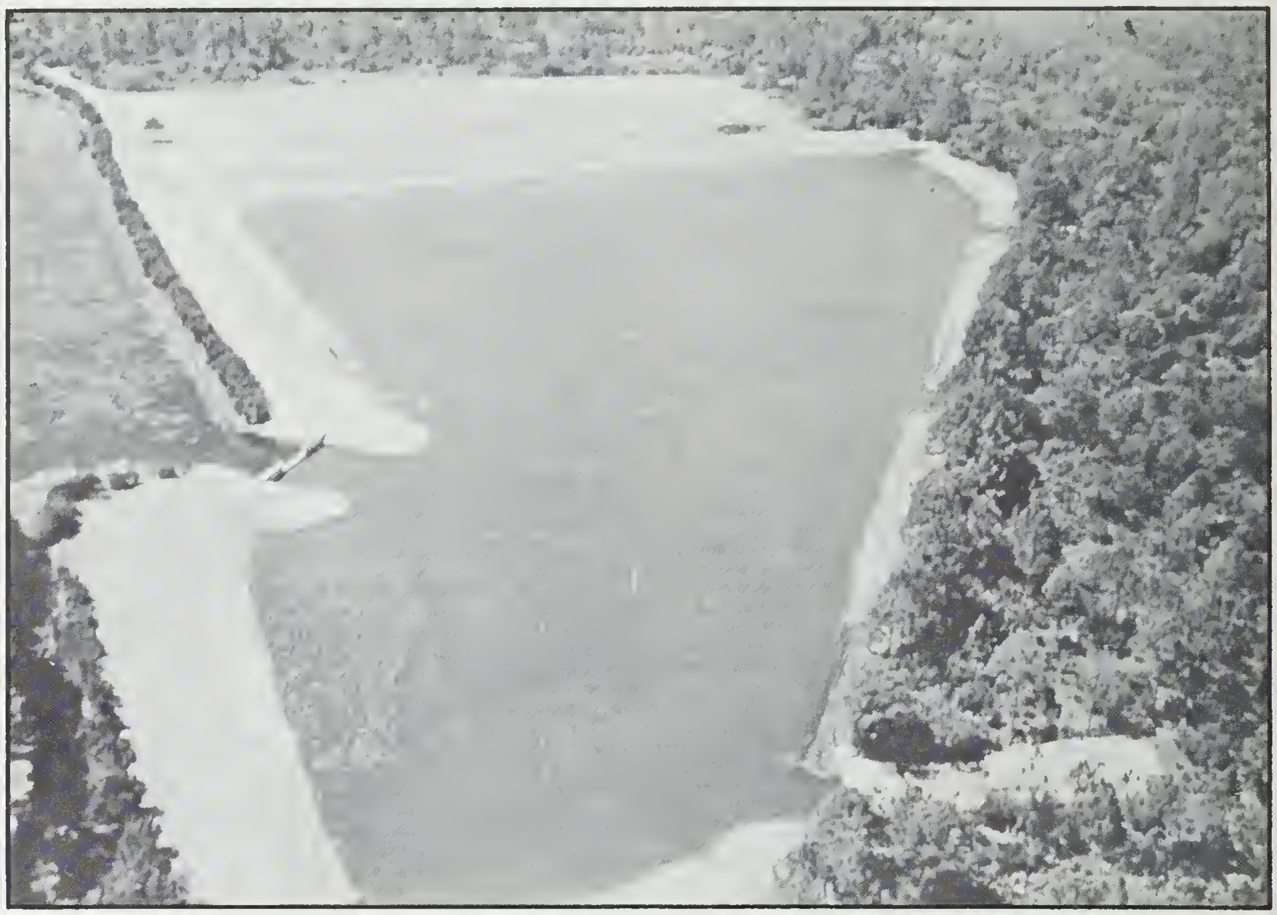
For further information, contact Sutton at the University of Florida, IFAS, FLREC, 3205 College Avenue, Fort Lauderdale, Florida 33314, (305) 475-8990.

PUTTING THEM TO GOOD USE

Transplanting approximately 70,000 aquatic plants served not only to create a "final outfall marsh" and meet wetland mitigation requirements, it also provided a successful example for future permit requests at **Westinghouse Gateway Communities** (WGC). A planned 5,300 acre community in Fort Myers (Lee County, Florida), the completed community is expected to have 20,000 dwelling units, commercial interests, schools and other public facilities.

The Westinghouse site is former agricultural land and an estimated 35% of the area was ditched and drained or otherwise impacted, including over 600 acres of cypress heads and seasonal ponds. The developers have kept and enhanced many ponds, marshes and non-forested wetlands. Lakes have been constructed around the marsh areas and are connected with vegetated flow ways. All water levels are controlled by weirs so that the hydroperiod can be extended, and the marshes are reported to be improving dramatically.

The WGC project is utilizing wetland plant species in two ways: "kidney marshes" and a "final outfall marsh". In cooperation with the SFWMD permit and mitigation requirements, "kidney marshes" have been created which function as biological filters of surface water run-off between golf courses and man-made lakes. The marshes were advised as a Best Management Practice by the SFWMD. After an initial disaster in which 7,000 transplanted St. John's wort plants (*Hypericum*) were destroyed when an adjacent golf course was sodded and sprayed with weed-killer, the kidney marsh was replanted with pickerelweed (*Pontederia*) and is now flourishing.



The second WGC project to use wetland plants is a 13-acre "final outfall marsh", which also meets wetland mitigation requirements of the development. The marsh is adjacent to the Six Mile Cypress Strand which is owned and protected by the county as an important water resource. The outfall marsh will flow into the strand and will be from 1-3' deep with water level controls. Approximately 70,000 plants have been relocated, mostly pickerelweed and cordgrass (*Spartina*) collected from the community site.

The next phase of the WGC development is being permitted now. Richard Anderson, Manager of Planning and a regional and urban planner with Westinghouse Development, says the success of the 13-acre outfall marsh, which has restored part of the natural watershed basin system and enhanced former wetlands and seasonal ponds, is a successful example to the permitting agencies. One aspect of the system's success is the increased wildlife in the area. Large numbers of birds frequent the marsh and otters have been sited.

Anderson says they are now spraying for control of cattails in the community (in conjunction with the Lee County Mosquito Control District), but would prefer to spend the money on aquascaping to hopefully control the nuisance species naturally. They plan to investigate this possible option in the future.

For more information, contact: Westinghouse Gateway Communities, 1625 Hendry Street, Suite 201, Ft. Myers, Florida 33901 (813) 337-1141.

LAKE MONROE PROJECT

The Florida Game and Fresh Water Fish Commission (FGFWFC) is planning the revegetation of Lake Monroe, a 9,500 acre lake in Seminole and Volusia counties, says Mr. Danon Moxley. Three of the four sites on the lake have been funded for revegetation with $48,000 from DER pollution recovery funds, and the FGFWFC hopes to see the fourth site funded as well.

The FGFWFC designed the project and Aurora, Inc. of Tampa will be providing and planting nursery grown giant bulrush, pickerelweed, maidencane, pondweed and eelgrass.

The plan is to revegetate 125 acres using over 95,000 plants. Although the commission had hoped to start planting in 1988, continued high water levels have forced them to delay planting, probably until spring of 1989. The FGFWFC hopes the Lake Monroe project will promote the aquatic nursery/revegetation industry.

ORGANIZATIONS

Association of Florida Native Nurseries
Native Green Cay, Route 1, Box 331-b
Boynton Beach, Florida 33437, (407) 496-1415
Publication: AFNN PLANT AND SERVICE LOCATOR

National Association of Environmental Professionals
P.O. Box 15210, Alexandria, Virginia 22309-0210, (703) 660-2364
Publications: THE NAEP NEWSLETTER and THE ENVIRONMENTAL PROFESSIONAL

Florida Native Plant Society
P.O. Box 680008, Orlando, Florida 32868
(407) 299-1472
Publication: THE PALMETTO

The Society for Ecological Restoration and Management
John P. Rieger, University of Wisconsin - Arboretum, 1207 Seminole Highway, Madison, Wisconsin 53711
Publication: RESTORATION AND MANAGEMENT NOTES.

Florida Lake Management Society
203 Lake Pansy, Winter Haven, Florida 33881, (813) 956-3771
Publication: THE NEWSLETTER OF THE FLORIDA LAKE MANAGEMENT SOCIETY

North American Lake Management Society
1000 Connecticut Avenue, N.W., Washington, DC 20036, (202) 466-8550
Publication: THE LAKELINE

Lakes Education/Action Drive (LE/AD)
Liberty Square, Suite 205, 1137 New Bartow Highway, Lakeland, Florida. 33801, (813) 688-2730
Publication: LAKEWATCH

American Wetlands Research Foundation, Inc.
95 Lighthouse Drive, Jupiter, Florida 33469
(407) 746-7290

Water Lily Society
P.O. Box 104, Buckeystown, Maryland 21717-0104, (301) 662-2230
Publication: THE WATER GARDEN JOURNAL

Florida Aquatic Plant Management Society
Brian Nelson, 1849 Meriadoc Road, Tallahassee, FL 32303
Publication: AQUATICS

National Wetlands Research Center
U.S. Fish and Wildlife Service, 1010 Gause Blvd., Slidell, LA 70458, (504) 646-7564
Publication: BIOLOGICAL REPORT SERIES

Notable Quotes from the Restoration Survey:

Here is a random selection of quotes from the Florida survey:

"**Our leading success was the creation of a 1200 acre wetland** for the city of Orlando, used as a collection wetland for municipal wastewater. We owe our success to the ability to collect and grow over two and a half million plants and the capability of mechanical planting. Our most prominent failure was the complete loss of a twelve acre retention pond. We are still pondering that one."

"**Field-harvested aquatics exhibit higher survivorship** than nursery-grown aquatics as they are better adapted to environmental fluctuations, which can be extreme at certain times of the year. Aquatic species which we formerly grew in our nursery are now field-harvested."

"**Non-nursery material almost always brings in undesirable plants** with it, even when careful."

"**Although developers frequently have a negative reaction to environmental agency mitigation requirements,** some of our clients have noted that a well-designed, aesthetically-pleasing shoreline can actually be marketed as an amenity, thus increasing the value of the lots or homes sold."

"**Some of the people designing and regulating some jobs seem totally unaware** of the generally accepted regimes and tolerances of the plants they're calling for."

"**We are having excellent success with the transfer of displaced wetland mulch** to newly created mitigation areas. The recruitment from the seed source and root stock is excellent in complementing the installed mature nursery-grown material in promoting a viable wetland in one growing season."

"**We use submerged grasses which help stabilize oxygen levels in lakes, and water lilies to shade out sunlight.** We allow 30% growth of plants on the lake bottom. The result is a lake which greatly controls algae problems naturally. In lakes where this program (is in place), we have reduced chemical use by two-thirds from previous years use. We also get improved water quality and improved lake ecology."

"**Out of 45 lakes in Orlando, we have successfully revegetated more than 30** using trees and macrophytes. These lakes are regularly maintained."

"British analyst, Mintel, measured the very hot market in water gardens. Sales **reached 110 million pounds (roughly $187 million) for 1987**, with predictions of as much as an 80% increase by the end of next year." American Nurseryman, June 1988.

LITERATURE AVAILABLE

The APIRS database contains some 300 citations on using aquatic plants for restoration, establishment, revegetation, transplanting, aquascaping and rehabilitation. Although not all citations are specific to restoration, there are several hundred articles applicable to the subject.

A free bibliography is available from APIRS on the research in the restoration field.

FROM THE DATABASE

Here is a sampling of recent research articles, books and reports which have been entered into the aquatic plant database since September, 1988.

To receive free bibliographies on specific plants and/or subjects, contact APIRS at the address shown on the mail label on page 16.

To obtain articles, contact your nearest state or university library.

Ali, A.; Reddy, K.R.; Debusk, W.F.
Seasonal changes in sediment and water chemistry of a subtropical shallow eutrophic lake.
Hydrobiologia 159(2):159-167, 1988.

Augsten, H.; Gebhard, A.
Der Einflub von schwermetallen auf die turionenbildung bei *Spirodela polyrhiza* (L.) Schleiden.
Wiss. Z. D. Pad. Hochsch. Potsdam 32:29-33, 1988.

Bernard, J.M.; Solander, D.; Kvet, J.
Production and nutrient dynamics in *Carex* wetlands.
Aquatic Botany 30:125-147, 1988.

Best, E.P.H.; Dassen, J.H.A.
Biomass, stand area, primary production characteristics and oxygen regime of the *Ceratophyllum demersum* L. population in Lake Vechten, The Netherlands.
Arch. Hydrobiol./Suppl. 76(4):347-367, 1987.

Best, E.P.H.
The submerged macrophytes in Lake Maarsseveen. I. Changes in species composition and biomass over a six year period.
Hydrobiol. Bull. 21(1):55-60, 1987.

Brix, H.
Light-dependent variations in the composition of the internal atmosphere of *Phragmites australis* (Cav.) Trin. ex Steudel.
Aquatic Botany 30:319-329, 1988.

Couch, R.; Nelson, E.
Myriophyllum quitense (Haloragaceae) in the United States.
Brittonia 40(1):85-88, 1988.

Damman, A.W.H.
Regulation of nitrogen removal and retention in sphagnum bogs and other peatlands.
Oikos 51(3):291-305, 1988.

Dervieux, A.; Tamisier, A.
Submerged macrophyte beds of Camargue wetlands: estimation of their distribution and size by the interpretation of air photos. (In French.)
Acta Oecologica 8(4):371-386, 1987.

Dinka, M.
The effect of mineral nutrient enrichment of Lake Balaton on the common reed (*Phragmites australis*).
Folia Geobotanica & Phytotaxonomica 21(1):65-84, 1986.

Djebrouni, M.; Huon, A.
Structure and biomass of a *Typha* stand revealed by multidimensional analysis.
Aquatic Botany 30:331-342, 1988.

Einarson, E.D.
The 1987 Eurasian water milfoil surveillance and control program in the Shuswap drainage basin.
Report, Littoral Resources Unit, Water Management Branch, Ministry of Environment and Parks, Province of British Columbia, 27 pp., 1988.

Gandy, E.L.; Yoch, D.C.
Relationship between nitrogen-fixing sulfate reducers and fermenters in salt marsh sediments and roots of *Spartina alterniflora.*
Appl. Environ. Microbiol. 54(8):2031-2036, 1988.

Gilderhus, P.A.
Persistence of rotenone in ponds.
N. Am. J. Fish. Mgmt. 7(1):162, 1987.

Goldsborough, L.G.; Brown, D.J.
Effect of glyphosate (Roundup formulation) on periphytic algal photosynthesis.
Bull. Environ. Contam. Toxicol. 41(2):253-260, 1988.

Gunatilaka, A.
Estimation of the available P-pool in a large fresh water marsh.
Arch. Hydrobiol. Beih. 30:15-24, 1988.

Haller, W.T.; Shilling, D.G.; Willard, T.R.; Glenn, M.S.
Diquat evaluation and determination of effects on aquatic plants.
EPA Subdivision J. - Hazard Evaluation: Non-target Plants Series 124-2, Aquatic Field Testing (Final Report - University of Florida, Gainesville), 68 pp., 1988.

Hamer, D.W.; Belcher, C.R.; Duell, R.W.
Registration of avalon salt meadow cordgrass.
Crop. Sci. 28(1):193, 1988.

Haramoto, T.; Ikusima, I.
Life cycle of *Egeria densa* Planch., an aquatic plant naturalized in Japan.
Aquatic Botany 30:389-403, 1988.

Haslam, S.M.
The macrophytic vegetation of the major rivers of Luxembourg.
Bull. Soc. Nat. Luxemb. 88:3-54, 1988.

Hasunuma, K.; Funadera, K.; Furukawa, K.; et al
Rhythmic oscillation of cyclic 3', 5'-AMP and -GMP concentration and stimulation of flowering by cyclic 3', 5'-GMP in *Lemna paucicostata.*
Photochemistry and Photobiology (in press), 1988.

Howard-Williams, C.; Clayton, J.S.; Coffey, B.T.; Johnstone, I.M.
Macrophyte invasions.
In: Inland Waters of New Zealand, edited by A.B. Viner, published by Science Information Publishing Center, Wellington, New Zealand. 494 pp., pp.307-331, 1988.

Johnsen, P.B.; Zhou, H.; Adams, M.A.
Olfactory sensitivity of the herbivorous grass carp, *Ctenopharyngodon idella,* to amino acids.
J. Fish Biol. 33(1):127-134, 1988.

Kane, M.E.; McConnell, D.B.; Sheehan, T.J.; Dehgan, B.
A laboratory exercise to demonstrate adventitious shoot formation using stem internodes of parrotfeather.
Hortscience 23(2):408, 1988.

Klotzli, F.
Conservational status and use of sedge wetlands.
Aquatic Botany 30:157-168, 1988.

Koncalova, H.; Pokorny, J.; Kvet, J.
Root ventilation in *Carex gracilis* Curt: diffusion or mass flow?
Aquatic Botany 30:149-155, 1988.

Nichols, A.B.
A vital role for wetlands.
J. Water Pollution Control Federation 60(7):1215-1221, 1988.

Nichols, S.J.; Schloesser, D.W.; Geis, J.W.
Seasonal growth of the exotic submersed macrophyte *Nitellopsis obtusa* in the Detroit River of the Great Lakes.
Can. J. Bot. 66(1):116-118, 1988.

Novak, V.A.; Ivankina, N.G.; Morokova, E.A.; Miclashevich, A.I.
The link between the electrogenic and redox functions of the plasmalemma and the energy metabolism of the cell.
Physiologia Plantarum 73:165-169, 1988.

Ormero, S.J.; Wade, K.R.; Gee, A.S.
Macro-floral assemblages in upland Welsh streams in relation to acidity, and their importance to invertebrates.
Freshwater Biology 18(3):545-558, 1987.

Orr, P.T.; Pokorny, J.; Denny, P.; Sale, P.J.M.
Photosynthetic response of *Myriophyllum salsugineum* (A.E. Orchard) to photon irradiance, temperature and external free CO2.
Aquatic Botany 30:363-378, 1988.

Patra, B.C.; Ray, A.K.
A preliminary study on the utilization of the aquatic weed, *Hydrilla verticillata* (L.F.) Royle as feed by the carp, *Labeo rohita* (Hamilton); growth and certain biochemical composition of flesh.
Indian Biologist 20(1):44-50, 1988.

Pesacreta, G.J.; Luu, K.T.
Feasibility of relating phenology and carbohydrate partitioning to improve aquatic plant control.
Miscellaneous Paper A-88-7, Waterways Experiment Station, Army Corps of Engineers, Vicksburg, Mississippi, 25 pp., 1988.

Rudd, J.W.M.; Kelly, C.A.; Schindler, D.W.; Turner, M.A.
Disruption of the nitrogen cycle in acidified lakes.
Science 240(4858):1515-1517, 1988.

Schuyler, A.E.
Submergent and planmergent flora of the freshwater portion of the Delaware Estuary (Chapter 10).
In: Ecology and Restoration of the Delaware River Basin, edited by S.K. Majumdar, E.W. Miller, and L.E. Sage, 1988, The Pennsylvania Academy of Science, pp. 157-168.

Singh, A.; Madan, M.; Vasudevan, P.
Biomass potentials of *Ipomoea fistulosa.*
Biological Wastes 25(2):141-143, 1988.

Smith, C.S.; Adams, M.S.; Gustafson, T.D.
The importance of belowground mineral element stores in cattails (*Typha latifolia* L.).
Aquatic Botany 30:343-352, 1988.

Smith, W.H.; Frank, J.R.; eds.
Methane from biomass: a systems approach.
Elsevier Applied Science Publishing Co., New York, 1988.

Snyder, G.H.
Flooding as a management practice in the Everglades Agricultural Area.
In: Agricultural Flooding of Organic Soils, Bulletin 870 (technical), G.H. Snyder, Editor, Agricultural Experiment Station, IFAS, University of Florida, Gainesville, pp.1-6, 1987.

Spencer B.
On-farm composting of aquatic weeds.
Biocycle 29(5):54-55, 1988.

Stewart, R.M.; Cofrancesco, A.F.
Biological control of waterhyacinth in the California Delta.
Technical Report A-88-7, Waterways Experiment Station, Army Corps of Engineers, Vicksburg, Mississippi, 44 pp., 1988.

Studer, C.; Brandle, R.
Post-anoxic effects of ethanol in rhizomes of *Glyceria maxima* (Hartman) Holmberg, *Iris germanica* L. and *Phragmites australis* (Cav.) Trin.
Botanica Helvetica 98(1):111-122, 1988.

Talbot, J.M.; Ward, J.C.
Macroinvertebrates associated with aquatic macrophytes in Lake Alexandrina, New Zealand.
New Zealand J. Marine and Freshwater Research 219(2):199-214, 1988.

Tate, R.L.; Riemer, D.N.
Aquatic weed biomass disposal: effect on soil organic matter.
J. Env. Qual., 17(1):163-168, 1988.

Timofeeva, S.S.; Stom, D.J.
Present condition and perspectives of using hydrobotanic treatment for sewage waters.
Acta Hydrochim. Hydrobiol. 16(3):299-312, 1988.

Wesche, T.A.; Goertler, C.M.; Frye, C.B.
Contribution of riparian vegetation to trout cover in small streams.
North American Journal of Fisheries Management 7:151-153, 1987.

West, S.D.; Langeland, K.A.; Laroche, F.B.
Analytical results from the determination of fluridone and n-methylformamide in pond water treated with the aquatic herbicide Sonar.
Initial Study Report, University of Florida, Gainesville, for Lily Research Laboratories, Greenfield, Indiana, 29 pp., 1988.

Williams, R.A.
Water quality program - aquatic plant control.
Report, 1987, Seneca County Soil & Water Conservation District, New York, 37 pp., 1988.

Wolaver, T.G.; Spurrier, J.D.
The exchange of phosphorus between a euhaline vegetated marsh and the adjacent tidal creek.
Estuarine, Coastal and Shelf Science 26(2):203-214, 1988.

Wolf, S.D.; Lassiter, R.R.; Wooten, S.E.; Hamala, J.A.
Modeling aquatic plant shoot accumulation of neutral chemicals.
Society of Environmental Toxicology and Chemistry Meeting, Nov. 1988.

Wolfe, L.M.; Barrett, S.C.H.
Temporal changes in the pollinator fauna of tristylous *Pontederia cordata*, an aquatic plant.
Can. J. Zool. 66(6):1421-1424, 1988.

Zirschky, J.; Reed, S.C.
The use of duckweed for wastewater treatment.
J. Water Pollution Control Fed. 60(7):1253-1258, 1988.

BOOKS/REPORTS

AQUATIC PLANTS - A guide to recognition by D. Spencer-Jones and M. Wade. 1986. 170 pp. ICI Professional Products.

(Order from Borcombe Printers Ltd., Publications Department, Unit 6 Budds Lane, Romsey, Hampshire SO51 OHA, United Kingdom. 7.50 British Pounds.)

This practical and easy-to-use pocket sized identification manual was designed for people who are not botanical taxonomists. The authors have greatly simplified for laymen the process of identifying aquatic plants.

Identification is simplified through the use of graphics which emphasize the few prominent characteristics of leaves, stems and flowers of individual genera and species. Anyone can "key out" the plants contained in this book, but for those of us who still rely on pictures the book includes excellent page-sized color photographs.

The manual has four sections based on whether the plants' leaves are emergent narrow-leaved, emergent broad-leaved, floating or submersed. The most important British species of 66 genera are included. Plants are further described by short notes on their ecology and morphology.

LAKE AND RESERVOIR RESTORATION by G.D. Cooke, E.B. Welch, S.A. Peterson and P.R. Newroth. 1986. 392 pp. Butterworth Publishers.

(Order from Butterworth Publishers, 80 Montvale Avenue, Stoneham, Massachusetts 02180 USA. $44.50.)

"This book details methods of managing and restoring eutrophic and acidified lakes and reservoirs. The procedures or manipulations presented are meant to be used after diversion, in conjunction with diversion, or to temporarily improve the lake without actual restoration. The authors examine each major restoration procedure to lower nutrient concentration or to control plant biomass with regard to its scientific basis, methods of application, known effectiveness, feasibility, drawbacks, and costs."

The procedures are divided into two groups - Physical and Chemical Methods to Reduce Nutrient Concentrations, and Procedures to Control Plant Biomass. Physical-chemical methods include wastewater diversion, hypolimnetic withdrawal, dilution and flushing, phosphorus inactivation, sediment oxidation, sediment removal, and hypolimnetic aeration. Plant biomass procedures include artificial circulation, drawdowns, plant harvesting, biological controls, and surface and sediment covers.

BIBLIOGRAPHY ON THE HYDRAULIC RESISTANCE OR ROUGHNESS OF VEGETATED WATERCOURSES by F.H. Dawson and F.G. Charlton. 1988. 50 pp. Freshwater Biological Association.

(Order from F.B.A., The Ferry House, Ambleside, Cumbria LA22 OLP, United Kingdom.)

Being able to predict volume and flow is essential for the design and management of flowing watercourses such as flood control and irrigation systems, streams and rivers. However, the occurrence of aquatic plants in these waterways replaces water volume and alters flow direction and speed. Therefore, aquatic plants affect the functioning of flowing systems as well as their wildlife and water quality. Engineers, botanists, zoologists, fishermen, conservationists and water managers all are interested in the effects of various species of aquatic plants on water volume and flow.

This bibliography of 363 research papers is keyed according to the contents of the various papers: comprehensive models, tall vegetation, short vegetation, very short vegetation, large scale bed roughness, studies on plant stands, ecological effects of water flow, morphological interactions, role of vegetation in erosion reduction and habitat improvement, roughness determinations, and flow and velocity measurement techniques.

THE USE OF MACROPHYTES IN WATER POLLUTION CONTROL - Proceedings of an IAWPRC Specialized Seminar held in Piracicaba, Brazil, 24-28 August 1986, edited by D. Athie and C.C. Cerri. 1987. 177 pp. Water Science and Technology Vol. 19 No. 10. International Association on Water Pollution Research and Control.

(Order from Pergamon Books, Inc., Maxwell House, Fairview Park, Elmsford, New York 10523 USA. $54.00.)

This is a collection of 15 papers presented at the IAWPRC seminar. They cover three topics: pollution abatement, problems and advantages related to the biomass, and soil treatment associated with the use of macrophytes.

VEGETATION BETWEEN LAND AND SEA - Structure and processes, edited by A.H.L. Huiskes, C.W.P.M. Blom and J. Rozema. 1987. 340 pp. Geobotany 11. Dr. W. Junk Publishers.

(Order from Kluwer Academic Publishers, P.O. Box 358, Accord Station, Hingham, Massachusetts 02018-0358 USA. $136.00.)

This is a collection of 24 papers concerning coastal waters, especially salt marshes. "The papers range from taxonomy to experimental physiology, from fungi to seed plants, from autecology to synsystematics. Environmental pollution and management studies are also included."

PERSISTENCE OF DICHLOBENIL IN LAKE SEMINOLE, GEORGIA, by W.R. Green and H.E. Westerdahl. 1988. 21 pp. Miscellaneous Paper A-88-6. U.S. Army Corps of Engineers.

(Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.)

Dichlobenil herbicide residues in the treated water column had a half-life of between 7 and 9 days, and had dissipated by 21 days post-treatment. Residues in the sediments had a half-life of between 16 and 28 days, and had dissipated by 55 to 104 days post-treatment.

WETLAND MODELLING, edited by W.J. Mitsch, M. Straskraba and S.E. Jorgensen. 1988. 238 pp. Developments in Environmental Modelling, 12. Elsevier Science Publishers.

(Order from Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, The Netherlands. $97.25.)

This book contains 12 chapters on mathematical modelling of wetlands. This is the first time APIRS has received a book about this relatively new field of science. Discussed are simulation and other models on hydrology, nutrient cycling, eutrophication, spatial distribution, and plant succession. The wetland types discussed range from intermittently flooded wet meadows to permanently flooded shallow reservoirs and lakes, coastal salt marshes, estuaries, bogs, reedswamps, forested swamps and regional wetlands.

SPREAD, IMPACT, AND CONTROL OF PURPLE LOOSESTRIFE (LYTHRUM SALICARIA) IN NORTH AMERICAN WETLANDS, by D.Q. Thompson, R.L. Stuckey and E.B. Thompson. 1987. 55 pp. Fish and Wildlife Research 2.

(Order from Publications Unit, U.S. Fish and Wildlife Service, Washington, D.C. 20240.)

This report documents the "exponential increase" and many environmental impacts of an exotic, very competitive plant which is already dominating wetlands and riverbanks of the eastern and midwestern U.S.

According to the authors, purple loosestrife (*Lythrum salicaria*) has already displaced many wetland communities by more than 50%. It is believed that the plant is responsible for the decline of waterfowl, furbearing animals and other vertebrates. As of now, very little research has been done on the ecology, biology, or chemical and biological control of this exotic plant. And so far only three states have declared purple loosestrife a noxious weed.

ALLIGATORWEED SURVEY OF TEN SOUTHERN STATES, by A.F. Cofrancesco, Jr. 1988. 120 pp. Miscellaneous Paper A-88-3. U.S. Army Corps of Engineers.

(Order from National Technical Information Service, 5285 Port Royal Road, Springfield, Virginia 22161.)

This report describes the current extent of the alligatorweed problem, describes the ecological adaptation, distribution and effectiveness of several species of biological control agents which have been released against alligatorweed, and makes management recommendations to increase the effectiveness of the biological control agents. The author's data indicates that alligatorweed is not a major problem throughout the southeastern U.S.

INVESTIGATION INTO THE DISAPPEARANCE OF EURASIAN WATER MILFOIL IN THE KAWARTHA LAKES, by D.S. Painter and K.J. McCabe. 1987. 58 pp. Report.

(Order from National Water Research Institute, Environment Canada, Burlington, Ontario, CANADA.)

Eurasian watermilfoil (*Myriophyllum spicatum*) invaded the Kawartha Lakes area of Ontario in the late 1960s. In the 1980s, several lakes have seen a decline, and even sudden disappearance, of the submersed weed. This report describes water chemistry analysis, sediment analysis, nutrient limitation, toxicity testing and other experiments relative to milfoil growth. None explained milfoil's sudden decline.

However, direct observation of extensive insect grazing did convince them: "Given the rapid disappearance of the milfoil from several locations in Scugog and Buckhorn Lakes during 1986, the insect grazing damage estimates for those lakes, and the high population of *Acentria* larvae relative to previously published population estimates, we conclude that insect grazing by the moth caterpillar was responsible for the disappearance of milfoil from Scugog and Buckhorn Lakes in 1986."

ECOLOGY AND PRODUCTIVITY OF AN AFRICAN WETLAND SYSTEM, The Kafue Flats, Zambia, by G.A. Ellenbroek. 1987. 267 pp. Geobotany 9. Dr. W. Junk Publishers.

(Order from Kluwer Academic Publishers, P.O. Box 989, 3300 AZ Dordrecht, The Netherlands. $125.00.)

This book is the result of 3 1/2 years of field study in Zambia to determine the effects of periodic water level fluctuations on the ecology and productivity of a large wetland. The water balance for this wetland is determined primarily by seasonal rains and by the operation of hydroelectric power dams.

This phytosociological study includes chapters on geomorphology, climate and hydrology, vegetation zonation, phenology, diversity, canopy structures and aboveground production, belowground vegetation and root/shoot ratios, and decomposition. After considering them all, the author concludes "as regards the ecology of the Kafue Flats, the outlook is not very prosperous."

INTERDISCIPLINARY APPROACHES TO FRESHWATER WETLANDS RESEARCH, edited by D.A. Wilcox. 1988. 163 pp. Michigan State University Press.

(Order from MSU Press, 1405 South Harrison Road, Suite 25, Manly Miles Building, East Lansing, Michigan 48823-5202. $18.00.)

This collection of 11 research papers comprises volume 7 of a series resulting from the 1986 Conference on Science in the National Parks. These papers cover "many of the interactions between the various disciplines used in wetlands research. It is only through awareness of the complexity of these interactions that wetlands research can be designed and conducted to accurately address the informational needs of land managers."

1988 AQUATIC WEED CONTROL GUIDE, by V.V. Vandiver. 1988. 130 pp. University of Florida, Institute of Food and Agricultural Sciences.

(Order from Publications, University of Florida, IFAS - Building 664, Gainesville, Florida 32611. $5.30 - Florida residents. $5.00 - others.)

This is a practical guide to the chemical control of aquatic weeds. Its seven chapters include general principles of weed control; general information about aquatic weeds; listing of aquatic weeds and herbicides registered for their control; labelled aquatic sites for specific herbicides; listing of herbicides, registrants and amount of active ingredient; maintenance, care and cleaning of application equipment; and aquatic weed terms and definitions.

AN ECONOMIC FRAMEWORK FOR LAKE RESTORATION ANALYSIS: A SIMULATION STUDY OF WATER HYACINTH PRODUCTION/METHANE CONVERSION STRATEGIES, by C.M. Fonyo. MS Thesis, University of Florida. 1987. 279 pp.

The BIOMET (BIOmass to METhane) simulation model was used to analyze and compare several management strategies to a waterhyacinth-based system which would be expected to restore better water quality to hypereutrophic Lake Apopka (Florida), and at the same time produce high-quality methane gas for commercial sale.

One of the primary reasons for "restoring" Lake Apopka is to re-establish the recreational fishing value of the lake which the author calculated could be $2.0 to $3.74 million (1981 $/yr). The author compared the costs of several lake restoration techniques (drawdown, dredging and wetlands creation, aeration, and chemical coagulation) to the waterhyacinth system. Estimated costs of restoration techniques for Lake Apopka ranged from $30.7 million (for drawdown) to $1.27 billion (for dredging and wetlands creation). The author determined that "in the simplest sense, the [state] subsidized water hyacinth system appears to be a more economically promising restoration method than the proposed alternatives with the exception of lake drawdown." However, she warns that "the reliability of the technical assumptions underlying this conclusion is questionable."

A HAND BOOK OF COMMON AQUATIC PLANTS OF THE KAINJI LAKE BASIN, NIGERIA, by E.A. Obot and J.S.O. Ayeni. 1987. 51 pp.

(Order from the National Institute for Freshwater Fisheries Research, P.M.B. 6006 New Bussa, Kwara State, NIGERIA.)

This is the first identification manual about the aquatic plants found in Lake Kainji, a man-made 1300 km^2 reservoir formed on the River Niger in 1968.

The manual was designed for non-botanists (such as fisheries managers) who work in the lake basin. The handbook presents photographs, descriptions, habitats and uses of 45 "true aquatic plants". The Hausa and Yoruba names for the plants are also given. (The Yoruba name for water lettuce (*Pistia stratiotes*) is Oju-oro. Water lettuce is said to be used in a "concoction for treatment of flu.")

AQUATIC AND WETLAND PLANTS OF KENTUCKY by E.O. Beal and J.W. Thieret. 1987. 312 pp.

(Order from the Kentucky Natural Preserves Commission, 408 Broadway, Frankfort, Kentucky 40601. $20.00.)

This identification manual contains keys, descriptions, line drawings and distribution maps for herbaceous aquatic and wetland plants found in Kentucky.

MITIGATING FRESHWATER WETLAND ALTERATIONS IN THE GLACIATED NORTHEASTERN UNITED STATES: AN ASSESSMENT OF THE SCIENCE BASE. Proceedings of a Workshop Held at the University of Massachusetts, Amherst, 29-30 September, 1986, edited by J.S. Larson and C. Neill. 1987. 143 pp. Publication No. 87-1.

(Order from The Environmental Institute, University of Massachusetts at Amherst, Blaisdell House, Amherst, Massachusetts 01003. $8.00.)

This collection contains eight papers and consensus reports on wetlands mitigation, especially in the northeastern U.S. The consensus reports specify what kinds of data regarding soils, vegetation and hydrology must be collected in order to accomplish wetland mitigation projects.

EDUCATIONAL PROGRAM NEEDS ASSESSMENT OF AQUATIC PESTICIDE APPLICATORS AND SUPERVISORS IN FLORIDA, by V.A. Ramey. MS Thesis, University of Florida. 1988. 91 pp., Gainesville.

The author randomly surveyed 419 of the approximately 1,500 "state certified" aquatic herbicide applicators and field supervisors in Florida. 231 questions and "agree-disagree" statements were used to determine their attributes, attitudes, beliefs and work behaviors. The purpose of the work was to collect data to be used to help plan and develop extension educational courses and materials for the aquatic plant management industry.

A REVISION OF THE GENUS NAJAS L. (NAJADACEAE) IN THE OLD WORLD, by L. Triest. 1988. 198 pp. Academie Royale des Sciences d'Outre-Mer. Classe des Sciences naturelles et medicales, Memoires in-8^0, Nouvelle Serie, Tome 22, fasc. 1.

(Order from Academie Royale des Sciences d'-Outre-Mer, Rue Defacqz 1 boite 3, B-1050 Bruxelles, BELGIUM.)

This taxonomic treatment describes 12 subspecies of *Najas marina* L., and describes 31 other *Najas* species (subgenus *Caulinia*). Diagnostic features, morphological keys and distribution maps are included. In addition, chapter 1 describes the history of the genus, its vegetative and reproductive morphology and biology, chromosomes, biochemistry, ecology, distribution, and includes a subchapter "Najas and Man" which describes effects of Najas infestations.

SCUM VIDEOTAPE

HARTBEESPOORT DAM - THE STORY OF A HYPEREUTROPHIC LAKE

This 14-minute VHS videotape program is about 3-foot-thick "hyperscums" on "the world's most hypertrophic lake". Hartbeespoort Lake is in South Africa.

The videotape documents phosphorus enrichment of this impoundment and the resulting exceedingly high growth rate of the alga *Microcystis aeruginosa*.

Large parts of the lake are covered with a hyperscum of *Microcystis*, a layer much like 3 feet of pistachio pudding. (When sampling in the layer, researchers must use core samplers rather than jars.) Even powerful boats have difficulty plowing through it.

The program points out that as of 1985, strict new laws require that effluent released into the lake have phosphorus concentrations of no more than 1 mg/l. Even so, models say the new regulations "will have no effect on chlorophyll concentrations."

The technically poor quality of the videotape is overcome by the very interesting subject matter.

For those willing to pay $150.00 U.S. for the videotape, contact:

CSIR, Division of Water Technology, P.O. Box 395, Pretoria 0001, SOUTH AFRICA.

AQUATIC PLANT SCHOLAR

For the fourth consecutive year, an outstanding college student has been recognized and awarded a cash prize from the **William L. Maier, Jr. Memorial Scholarship Fund.** The Fund is administered by the Florida Aquatic Plant Management Society (F.A.P.M.S.) Scholarship and Research Foundation, Inc. William L. Maier, Jr. was a charter member and past president of F.A.P.M.S. and a recognized leader in Florida's aquatic plant management.

This year's winning student scholar is **Mr. Mark Mossler**, pictured at right. He received the $600.00 prize money from Dr. Joe Joyce at the F.A.P.M.S. annual meeting in October. Mossler is a graduate student in the University of Florida Agronomy Department, under the direction of Dr. Donn Shilling. As part of his studies, he is investigating the rate of photolytic and microbial degradation of fluridone in water.

The scholarship fund was established to recognize students who are working in a natural resource field "for the ecological benefit of aquatic or wetland environments." Applicants for the scholarship must be enrolled as upper level undergraduate or graduate students in a Florida institution and must submit a 500 - 1,000 word essay relating aquatic plant management to the "preservation of Florida's aquatic resources, public health, fish and wildlife habitats, irrigation and flood control systems, and/or agriculture."

For more information about this annual prize, contact Dr. Joe Joyce, Secretary/Treasurer, F.A.P.M.S. Scholarship and Research Foundation, Inc., 7922 N.W. 71st Street, Gainesville, Florida 32606.

MEETINGS

ANNUAL AQUATIC PLANT RESEARCH REVIEW AND ADVANCED AQUATIC PLANT MANAGEMENT SHORT COURSE. Early March, 1989, Fort Lauderdale, Florida.

This research review and advanced short course is designed for supervisors, managers and policy makers involved in aquatic plant management. The dates for the two-day meeting are not yet definite. For more information, contact Dr. Ken Langeland or Dr. Joe Joyce at the University of Florida IFAS Center for Aquatic Plants, (904) 392-9613.

FLORIDA AQUATIC WEED SHORT COURSE. Summer, 1989, South Florida.

Because of the high demand for the June, 1988 Applicator Short Course, IFAS is planning another one. The date and place is uncertain at this time, but the short course will be held in South Florida sometime during summer, 1989. For further information, contact Dr. Vernon Vandiver, IFAS-REC, 3205 College Avenue, Ft. Lauderdale, FL 33314 (305) 475-8990 **OR** Dr. Ken Langeland, IFAS Center for Aquatic Plants, 7922 N.W. 71st Street, Gainesville, FL 32611 (904) 392-9613.

8TH INTERNATIONAL SYMPOSIUM ON AQUATIC WEEDS, EUROPEAN WEED RESEARCH SOCIETY. August 13-17, 1990, Swedish Agricultural University, Uppsala, SWEDEN.

Previous E.W.R.S. symposia have always attracted the preeminent international researchers on aquatic weeds. We at APIRS have found that the printed proceedings from these symposia are among the most desired and valued resources of aquatic plant researchers, water managers and government personnel. Dr. Richard Couch, President of the Aquatic Plant Management Society, has conveyed a special invitation from E.W.R.S. for APMS members to attend the 8th symposium.

For more information, contact: Dr. Kevin Murphy, Department of Botany, The University of Glasgow, Glasgow G12 8QQ, Scotland, UNITED KINGDOM.

SIXTEENTH ANNUAL CONFERENCE ON WETLANDS RESTORATION AND CREATION. May 25-26, 1989, Tampa, Florida.

"This annual conference provides a forum for the nationwide exchange of results of scientific research in the restoration, creation, and management of freshwater and coastal wetlands systems. Those interested in presenting a paper are invited to submit an abstract having approximately 250 words by February 13, 1989. Topics include freshwater, estuarine, and marine wetland systems; marsh, mangrove and seagrass restoration; mitigation, permitting and regulatory policies; mine reclamation, and management techniques."

For more information, contact: Mr. Frederick J. Webb, Director of Economic Development, Hillsborough Community College, Plant City Campus, 1206 North Park Road, Plant City, Florida 33566 (813) 757-2104.

BIOCONTROL MISTAKE - Part II: Rebuttal

by Sandra Davis with Gary Buckingham, U.S.D.A., A.R.S., Biological Control Lab., P.O. Box 1269, Gainesville, Florida 32602 (904) 372-3505.

[The spring issue of AQUAPHYTE implied that "biocontrol" made a "mistake" when "in the 1930s nutrias (Myocastor coypus), semi-aquatic furbearing rodents, were imported from South America to Louisiana to help clear the state's waterhyacinth-choked coastal waterways." The source was an article in the December 1987 AQUANOTES (Louisiana State University Sea Grant College Program) entitled "The Imported Plague": "In the 1930s it looked like a good idea: control the growth of water hyacinth and other aquatic weeds that were choking Louisiana's coastal waterways by releasing nutria into the marsh to eat them."]

We believe that referring to nutria as a "biocontrol mistake" is a good example of how rumors begin and persist. We are especially concerned because rumors about alleged "biocontrol mistakes" could affect support of biological control research. In fact, we believe that this has happened before: public officials equating all introductions of foreign organisms with biocontrol, resulting in long-term delay of biocontrol programs.

According to an authority on nutria, that animal's original introduction into California (1899) and Louisiana (1937) had nothing to do with management of aquatic weeds; they were imported for fur-farming (Evans, 1970). Later, of course, they were sold by get-rich-quick artists as "weed cutters".

The nutria issue recalls an episode in United States history involving the Secretary of War's decision not to fund biological control of water hyacinth in Florida. Ninety years ago (1898), the Acting Secretary of War, G.D. Meiklejohn, reported to the 55th Congress that he did not recommend natural control agents of water hyacinth because "The English sparrow, the rabbit in Australia and the introduction of the Australian lady bug in California to kill the white scale on the orange trees are notable instances of the undesirability attending the carrying out of such experiments" (House of Representatives Document No. 91).

Let's look at these instances. The research literature shows that the English sparrow was imported from England in 1850 to help control canker worms in Brooklyn and thus might be considered an example of biocontrol. However, this first attempt at biocontrol in the United States was not the work of the mature discipline that we know it to be today. The mid-19th century was a time when modern biology and technology was still in its infancy: Charles Darwin did not publish *The Origin of Species* until 1859, and Edison didn't invent the commercially practical incandescent lamp until 1879.

The domestic rabbit was first released in Australia as early as 1788 with the First Fleet, and subsequent introductions were made into Australia by "acclimatisation societies", whose purpose was to "enrich the country and enhance its attractions" (Myers, 1986). Rabbit introductions were also made for fur and food (Rolls 1969). The detrimental effects on native vegetation and ecology which followed are well documented. But introduction of the rabbit for the above reasons is obviously not biocontrol, since nothing was targeted for control except perhaps the hunger pangs of the settlers. Yet even today we occasionally hear arguments against biocontrol using the Australian rabbit story as proof of biocontrol dangers. The Australian rabbit story is useful, however, to underscore the need for careful host-range testing before releasing any new organism into the environment. Interestingly, the Australian rabbit populations were eventually controlled biologically by a virus (Huffaker, 1976).

We cannot know what Secretary Meikeljohn had in mind when he mentioned the introduction of the Australian lady bug to kill the white scale on California orange trees, but next year California will celebrate the 100th anniversary of the release of the Australian lady bug and its control of the white scale (cottony cushion scale). If Secretary Meikeljohn had prevented the importation of the Australian lady bug as successfully as he prevented development of biocontrol of water hyacinth in the waterways of Florida and Louisiana, California might not be an orange-producing state today.

As it is, it took almost seventy-five years before insects were again considered a useful and inexpensive means of water-hyacinth control in the U.S. Even today - at scientific meetings, in the media and in everyday conversations - people point to the dangers of biocontrol based on rumors and hearsay. Even modern-day decision-makers still discount the potential of biocontrol because of their lack of knowledge. We need to control these rumors before letting our imaginations run away with them.

[For a simple chronology of biological control programs in the U.S., see the next page.]

AQUANOTES. 1987. The imported plague. 16(4):1-5. Louisiana Sea Grant College Program, Louisiana State University, Baton Rouge.

AQUAPHYTE. 1988. Biocontrol mistake? 8(1):1-2. Center for Aquatic Plants, IFAS, University of Florida, Gainesville.

Debach, P. 1974. Biological control by natural enemies. Cambridge University Press, New York.

Evans, J. 1970. About nutria and their control. U.S. Department of the Interior, Bureau of Sport Fisheries and Wildlife Resource Publication No. 86 (August 1970).

Goeden, R.D. 1978. Biological control of weeds. In: Introduced parasites and predators of arthropod pests and weeds: A world review. ARS, U.S.D.A. Agric. Handbook No. 480, pp.357-414.

Huffaker,C.B. and P.S. Messenger. 1976. Theory and Practice of Biological Control. Academic Press, New York.

Long, J.L. 1981. Introduced birds of the world. Universe Books, New York.

Myers, K. 1986. Introduced vertebrates in Australia, with emphasis on the mammals. In: Ecology of Biological Invasions, edited by R.H. Groves and J.J. Burdon. Cambridge University Press, New York.

Rolls, E.C. 1969. They all ran wild: the story of pests on the land in Australia. Angus and Robertson Ltd., Sydney.

U.S. Congress, House of Representatives. 1898. Water hyacinth obstructions, 55th Congress Document No. 91. Available from the U.S. Government Printing Office, Washington, D.C.

BIOCONTROL CHRONOLOGY

"Biological control" techniques have been used as far back as 1200 A.D. when Chinese farmers put ant nests in citrus and litchi trees to control shield bugs (Huffaker 1976).

The following is a partial list of early biological control programs against insects:

- 1888-89 vs the cottony cushion scale in California
- 1904 vs sugar-cane leafhopper in Hawaii
- 1905 vs gypsy moth and browntail moth in New England
- 1907 vs sugar-cane beetle borer in Hawaii
- 1910 vs citrus whitefly in Florida
- 1925 vs spiny blackfly in Japan
- 1925 vs coconut moth in Fiji
- 1928 vs Citrophilus mealybug in California
- 1930 vs citrus blackfly in Cuba
- 1932 vs sugar-cane borer in the Caribbean
- 1933 vs coconut leaf-mining beetle in Fiji
- 1938 vs coffee mealybug in Kenya

The following is a list of biological control successes against weeds:

- early 1900s - thrips vs Koster's Curse in Fiji
- 1902 - insects from Mexico vs lantana in Hawaii
- 1920-1935 - a scale insect and caterpillar vs prickly pears in Australia
- 1940s - leaf beetles vs Klamath weed in California
- 1960s - flea beetle vs alligatorweed in coastal southeastern U.S.
- 1970s - weevils vs water-hyacinths in coastal southeastern U.S.
- 1980s - weevils vs giant salvinia in Australia and New Guinea

DNR HOLDS AQUATIC PLANT I.D. COURSE

Approximately 150 aquatic plant species were displayed for 55 participants in the 8th annual aquatic plant identification course presented in Live Oak, Florida on April 12-15, 1988. A primary purpose of the course is to provide a refresher for those participating in the annual DNR Florida Aquatic Plant Survey. The course was organized by Mr. Jeff Schardt of the Florida Department of Natural Resources Bureau of Aquatic Plant Management.

Dr. David Hall of the University of Florida provided an aquatic plant identification session emphasizing scientific names and offering clues for differentiating between similar species.

Mr. Larry Nall, also of the Bureau, demonstrated remote sensing and digital mapping techniques, including LANDSAT, LORAN, and aerial photography. A digitizer was available for demonstrating plant coverage mapping techniques which provide more accurate statistics on plant coverage of water bodies.

A survey test was given to participants which allowed 1-1/2 hours to measure the size of a water body adjacent to the teaching facility, name the aquatic plant species present and the area of coverage of each, including submersed plants. Recording fathometers were used for detecting submersed species. Airboats were also available for surveying the lake.

For information on future courses, contact Mr. Jeff Schardt, Bureau of Aquatic Plant Management, Cedars Executive Center, 2639 North Monroe Street, Building B, Box 19, Tallahassee, Florida 32303, (904)488-5631.

New Depth Record

Elodea canadensis has now been found growing at depths of 14 m (46 feet). Two Spanish aquatic plant researchers recently reported the find in the Torrassa reservoir, Pyrenees region, Spain. The reservoir is "wholy dominated" by the submersed plant. They claim that this "represents a new maximum depth penetration for freshwater angiosperms with lacunae."

Penuelas, J. and A. Verdaguer. 1987. *Elodea canadensis* Michx a l'embassament de la Torrassa: Record de fondaria per a una fanerogama d'aigua dolca. Butll. Inst. Cat. Hist. Nat. 54(6):79-81. (In Portuguese)

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AQUAPHYTE

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EDITOR: Victor Ramey

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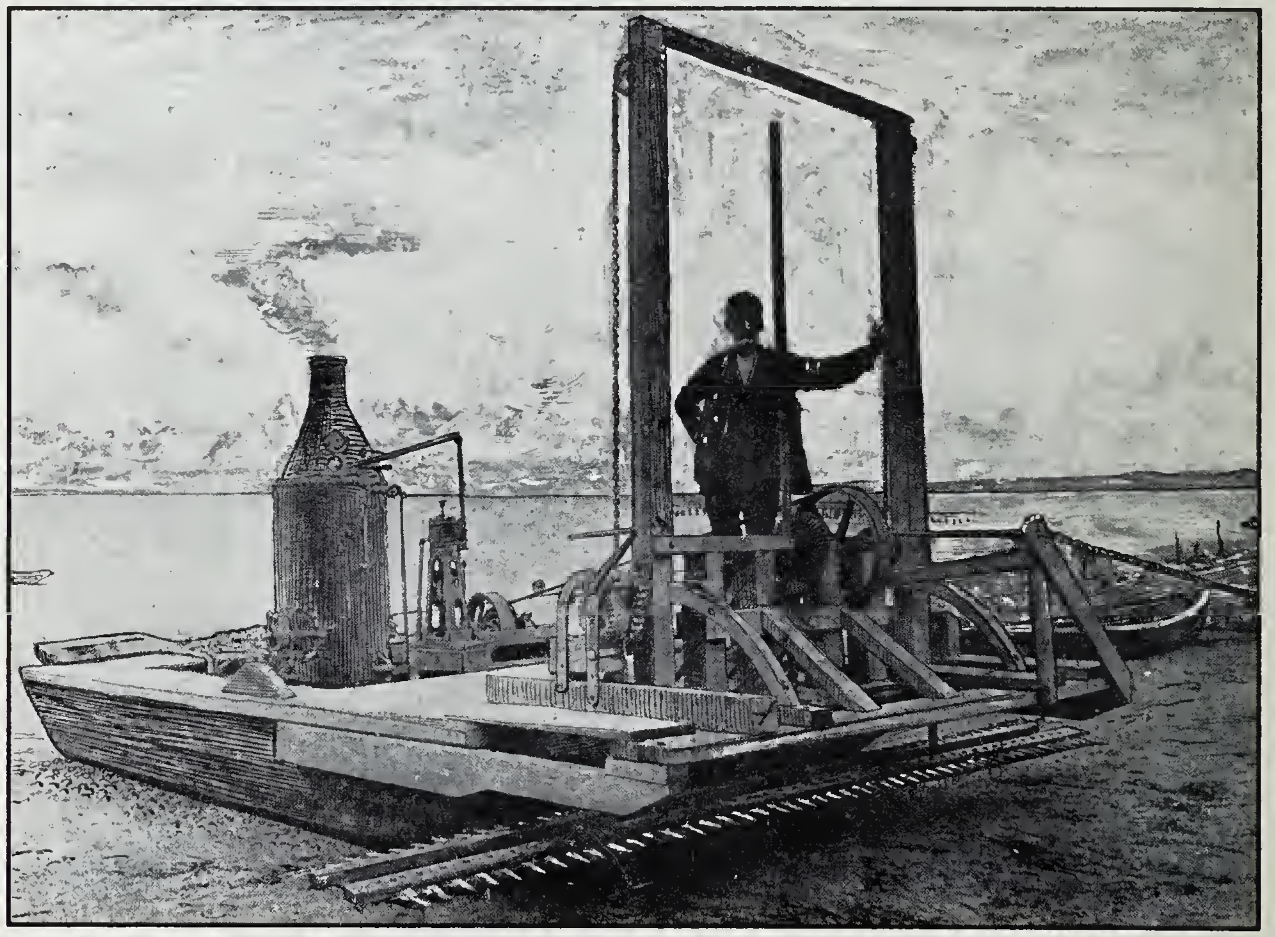
AQUAPHYTE is sent to 3,500 U.S. and Canadian managers, researchers and agencies. Comments, announcements, news items and other information relevant to aquatic plant research are solicited.

We gladly permit free republication of *AQUAPHYTE* items when accompanied by full acknowledgement.



Aquatic plant cutting machine, circa 1892.

"Owing to the necessity for periodically removing the aquatic foliage at pond-culture stations and the expense involved in the present methods of performing this task, it is obvious that here also is a field for experimentation. In this connection it seems proper to refer to the success of Mr. Charles T. Allen, who some years ago devised an aquatic mowing machine for the purpose of cutting eel grass on oyster grounds. Mr. Allen asserts that the machine will cut 2,400 square feet of grass per minute in water 6 feet deep. Undoubtedly the machine is too large and heavy for use in small ponds, but it might perhaps be modified to suit the requirements of pond culture if the cutting knives can be successfully used on the vegetation of ponds. Gasoline or hand power could be substituted for steam power."

From: Titcomb, J.W. 1909. *Aquatic Plants in Pond Culture.* Department of Commerce and Labor, Bureau of Fisheries, Washington, D.C. Document No. 643.